ENVIRONMENTAL IMPACT STATEMENT

EIS NUMBER 01-81

MENDOTA POOL 10-YEAR EXCHANGE AGREEMENTS

DRAFT

MAY 21, 2003

United States Department of the Interior
South-Central California Area Office
1243 “N” Street
Fresno, California 93721-1813

BUREAU OF RECLAMATION
UNITED STATES DEPARTMENT OF THE INTERIOR

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Abstract: This environmental impact statement evaluates the proposed exchange of up to 25,000 acre-feet of water per year over a 10-year period between the U.S. Bureau of Reclamation (Reclamation) and the Mendota Pool Group (MPG). Reclamation's purpose in authorizing this action is to facilitate the efficient delivery and re-allocation of water to facilitate environmental and economic benefits as authorized by 34 U.S.C. §3408(d), Central Valley Project Improvement Act (CVPIA). The need for the proposed authorization is to facilitate improvements in the reliability of irrigation water delivery to the San Luis Canal without affecting CVP water deliveries at Mendota Pool. The proposed action will offset cutbacks in CVP irrigation water supplies as a more balanced distribution of water among competing uses is sought. The MPG proposes to pump non-CVP groundwater into the Mendota Pool and exchange it with water from the CVP. This exchanged water will be delivered to land owned by MPG members elsewhere within the CVP service area. The proposed project is the result of discussions since the early 1990's and includes a baseline pumping program, design constraints, monitoring program, and an adaptive management approach. Two No Action alternatives are also considered: construction of new wells on MPG properties, and fallowing land. Six primary resource areas are evaluated: groundwater levels, land subsidence, groundwater quality, surface water quality, sediment quality, and biological resources. Six other resources areas are also evaluated. The proposed project would have less-than-significant effects on all resource areas except groundwater quality. The project would result in a significant cumulative effect on groundwater quality adjacent to the Pool. The two alternatives would significantly increase the cost of the water obtained and could also affect groundwater and subsidence in other areas.

Contact:
Mr. David Young
United States Department of the Interior
South-Central California Area Office
1243 "N" Street
Fresno, California 93721-1813
(559) 487-5127

Comments on this Draft EIS must be received on or before July 21, 2003

This environmental impact statement (EIS) evaluates the proposed exchange of up to 25,000 acre-feet of water per year over a 10-year period between the U.S. Bureau of Reclamation (Reclamation) and the farmers comprising an unincorporated association known as the Mendota Pool Group (MPG). Reclamation's purpose in authorizing this action is to facilitate the efficient delivery and re-allocation of water to achieve environmental and economic benefits as authorized by 34 U.S.C. §3408(d), Central Valley Project Improvement Act (CVPIA). The need for the proposed authorization is to facilitate improvements in the reliability of irrigation water delivery to the San Luis Canal (SLC) [at Check 13 on the Delta Mendota Canal (DMC)] without affecting CVP water deliveries at Mendota Pool. The proposed action will offset cutbacks in CVP irrigation water supplies as a more balanced distribution of water among competing uses is sought.

Since 1989, water supplies to CVP agricultural users have been drastically reduced in a mandatory effort to balance competing non-agricultural benefits of the CVP. Between 1980 and 1989, water deliveries to Wetlands Water District (WWD) averaged 103% of the District's entitlements. However, since that time deliveries have averaged 63.8%. This reduction in water deliveries from the CVP has required that agricultural users obtain a large portion of their water requirements from supplemental sources such as groundwater. Groundwater has long been an important water source for farmers within the WWD and SLWD service area. Prior to the construction of the CVP in 1963, groundwater was the primary source of irrigation water (WWD 1999). To make up for the shortfall in surface irrigation water since 1989, landowners and water users within the districts have drilled wells to obtain supplemental water.

MPG members own approximately 50,000 acres of historically irrigated farmland in WWD and San Luis Water District (SLWD). These lands are not adjacent to the Pool and depend on deliveries from the SLC (California Aqueduct) to WWD and SLWD for irrigation water. There are no other supplemental sources of surface water that can be used for these lands.

The MPG proposes to pump non-Central Valley Project groundwater from their wells into the Mendota Pool and exchange it with water from the Central Valley Project (CVP), which is administered by Reclamation. This exchanged water will be delivered to land owned by MPG members elsewhere within the CVP service area. The objective of the proposed project is to enable the MPG to maintain production on historically irrigated lands by obtaining sufficient water at cost-effective prices to offset cutbacks in CVP deliveries. The project is not intended to increase the amount of water for farming activities but would replace water allocated for other CVP purposes.

This EIS analyzes the environmental effects of the 10-year proposed project and two no action alternatives on the quantity and quality of groundwater and surface water resources in the vicinity of the Mendota Pool. Section 1 of this EIS describes the purpose and need for the proposed exchange. The proposed project and alternatives are described in detail in Section 2. Section 3 of this document describes the environmental setting and includes a detailed summary of monitoring data collected between 1999 and 2002. Section 4 evaluates the potential for effects of the proposed project and alternatives on the environmental resources in the project vicinity.

ES.1 PROPOSED PROJECT

The project that is the subject of this EIS is the result of ongoing discussions between the project proponents (i.e., the MPG), Reclamation, local water districts, the Regional Water Quality Control Board (RWQCB), Fresno and Madera Counties, the City of Madera, U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG), and adjacent landowners since the early 1990's. Throughout these discussions, numerous potential impacts have been identified, and mitigation actions proposed. The mitigation actions are included in the proposed pumping program as design constraints. As described in this EIS, the proposed project includes a baseline pumping program, numerous design constraints, a monitoring program, and an adaptive management approach to implementation of the pumping program based on the results of the monitoring program.

Five primary resource areas were identified in previous environmental documents: groundwater levels, land subsidence, groundwater quality, surface water quality, and biological resources. This EIS addresses those five resource areas and includes an evaluation of potential impacts to sediments, and historical and societal resources. Resource areas evaluated in this EIS for potential impacts include:

- Groundwater levels
- Land subsidence
- Groundwater quality
- Surface water quality
- Sediment quality
- Biological resources
- Central Valley Project operations
- Archaeological and cultural resources
- Land use and traffic
- Air quality
- Noise
- Environmental justice
- Socioeconomics

The primary area of interest for this EIS includes portions of western Fresno County and southwestern Madera County. Because the No Action alternatives would take place in WWD and SLWD, these regions are also considered relative to the No Action alternatives. The area of interest for the evaluation of potential effects is dependent on which primary environmental issue of concern is being addressed and which project alternative is being evaluated.

The project proponents propose to pump up to 269,600 acre-feet of groundwater for transfer over a ten-year period from wells located adjacent to the Mendota Pool into the Mendota Pool. The maximum allowable quantity of water to be pumped in a given year would depend on whether the year is classified as wet (0 acre-feet per year), normal (up to 31,600 acre-feet per year), or dry (up to 40,000 acre-feet per year). However, no more than 25,000 acre-feet of water would be exchanged with Reclamation each year; the remaining water would be exchanged with other users around the Pool. The MPG will determine the classification of each year during the spring, based primarily on estimated water demands and the projected allocations for that year. The projected allocations will be based in part on the April 15 estimate of agricultural water allocations made by Reclamation each year.

Transfer pumping would be conducted over a maximum of 9 months each year, between March 1 and November 30. The annual pumping programs would consist of three seasonal components: spring, summer, and fall. During the spring (March through May), both shallow (< 130 feet deep) and deep (> 130 feet deep and above Corcoran Clay) wells would be pumped. During the summer (June through mid-September), only shallow wells would be pumped. However, during years when the program does not begin until after April 1, deep wells may be pumped during the month of June. During the fall (mid-September through November), both shallow and deep wells would be pumped.

The groundwater pumping program will be adaptively managed to minimize environmental impacts. Pumping programs will be developed and reviewed on an annual basis to allow for year-to-year variations in hydrologic conditions and will be defined in the spring, prior to the start of pumping. Each pumping program would be based on consideration of several factors including the design constraints (e.g., water quality at Exchange Contractor's canal intakes or at MWA; see Section ES.3), the results of the previous year's monitoring program, the extent of groundwater level recovery, hydrologic conditions, and any Reclamation contractor's rescheduling of CVP deliveries from the previous water year.

Adjustments will be made to the pumping program if the monitoring program indicates that actions need to be taken to maintain water quality in the Mendota Pool. The results of the annual monitoring programs will be used as input to a series of groundwater and surface water models to forecast subsidence and water quality impacts to design the next year's pumping program and to ensure that all design constraints are met. The models will be periodically reviewed and improved as more data become available.

ES.2 ALTERNATIVES

This EIS evaluates two No Action alternatives to the proposed project. These alternatives were identified as the most probable alternatives should the proposed project not be implemented. These alternatives assume that Reclamation does not allow the proposed exchange of groundwater pumped into the Mendota Pool for water taken from the DMC at Check 13. Therefore, the MPG would not be able to obtain supplemental (i.e., exchanged) water via the SLC for delivery to their farmlands in WWD and SLWD. The No Action alternatives assume the continuation of efforts to secure water transfers and implement water conservation programs. The current level of groundwater pumping for local use by farmers and others in the Mendota region would remain without the project.

Should Reclamation decide not to implement the Proposed Action, then the MPG members would independently seek to obtain water from other sources in order to maintain agricultural production to the fullest extent possible. This EIS considers two options that are the most feasible and could be implemented by the MPG. These options are:

- New Well Construction – To provide 25,000 acre-feet of groundwater per year between 75 and 125 new wells would need to be drilled on MPG lands.

- Land Fallowing – To compensate for the 25,000 acre-feet of water that would not be obtained through this exchange, approximately 10,000 acres of land would have to be taken out of production (approximately 20 percent of MPG lands). This land would be taken from non-permanent crops and would be removed on a rotating basis.

In addition to these alternatives, the MPG would continue to pump up to 9,000 acre-feet per year into the Mendota Pool for exchange or trade with other users around the Mendota Pool or conveyed to WWD via Laterals 6 or 7. The amount of water traded would depend on the amount of water available from existing Reclamation CVP contractors receiving CVP project water at the Mendota Pool, cropping patterns, availability of conveyance capacity, and amount of land fallowed. This action would not require any State or Federal permits.

In the analysis presented in this EIS, the Well Construction and Land Fallowing options are treated as independent actions. In reality, individual members of the MPG may choose either of these options, or choose some combination of the two.

ES.3 DESIGN CONSTRAINTS

The proposed project incorporates several design constraints intended to prevent adverse environmental effects. Some of these constraints were initially specified in the Settlement Agreement between the MPG, the SJREC, and NLF. Additional constraints were developed based on the results of previous monitoring efforts and to address concerns of other water users around the Mendota Pool. The constraints apply to the initial design of the annual pumping programs, and to triggers based on the results of the annual monitoring program. These design constraints include:

- Pump MPG wells along the Fresno Slough only when flow in the Fresno Slough is to the south. Wells in FWD could pump irrespective of flow direction.

- Shut off MPG wells if electrical conductivity (EC) measurements at the Exchange Contractors' canal intakes exceed that of the DMC by 90 µmhos/cm for a period of three days or more. If the MPG wells are shut off for this reason, they would not be turned back on until the EC at the canal intakes returns to a level that is no more than 30 µmhos/cm above the DMC inflow.

- Minimize deep zone drawdowns by reducing MPG deep zone transfer pumping during the summer months when the majority of non-MPG irrigation pumping occurs in the Mendota area.

- Limit total transfer pumping from the deep zone to 12,000 acre-feet per year to reduce subsidence, reduce water level impacts, and minimize the rate of groundwater quality degradation that would otherwise occur.

- Limit deep zone drawdowns throughout the pumping program to limit subsidence at the Yearout Ranch and Fordel extensometers caused by transfer pumping to less than an average of 0.005 foot per year over the ten-year period. Compaction data collected from the extensometers will be used along with model results to estimate the amount of subsidence cause by MPG pumping each year.

- Modify the pumping program based on the results of the surface water monitoring program to reduce overall surface water quality degradation, particularly with respect to salinity [total dissolved solids (TDS) or EC]. This will ensure that the quality of water supplied to the MWA and other users in the southern portion of the Mendota Pool will meet applicable water quality criteria. Wells with TDS concentrations greater than 2,000 mg/L will not be pumped as part of the proposed action. During the fall pumping period, when there is reduced flow in the Mendota Pool and water quality at the MWA is most critical, wells with TDS higher than 1,200 mg/L will not be pumped for transfer.

- Shut off wells with selenium concentrations equal to or greater than the surface water quality criterion of 2 μg/L.

- Minimize groundwater quality degradation by modifying the pumping program based on the results of predictive modeling of the effects of the pumping program and the results of the groundwater monitoring program, and by minimizing drawdowns.

- Five MPG wells (Farmers Water District WL-1, WL-2, WL-3, EL-2, and EL-3) will not be pumped for transfer, and will not constitute part of the exchanged waters as they are located in Madera County.

- Beginning with the 2001 irrigation season, the MPG has offered to compensate the other major groundwater pumpers in the Mendota area for increased power and other additional costs due to drawdowns estimated to have been caused by the MPG transfer pumping.

ES.4 MONITORING PROGRAM

The MPG has designed a surface water, groundwater, sediment, and subsidence monitoring program to assess the impacts of this project. The current monitoring program was developed with input from the USFWS, the U.S. Geological Survey (USGS) and the CDFG. The monitoring program was initiated in 1999 and is planned to last for the duration of the project. The complete monitoring program is described in Appendix B. The monitoring program consists of the following components:

- Monitor pumpage of the MPG wells on at least a monthly basis
- Measure groundwater levels on a bimonthly basis throughout the year
- Sample groundwater quality on an annual basis
- Evaluate data from continuous EC recorders located at the DMC, the Exchange Contractors' intakes, and the MWA
- Conduct surface water quality sampling during the pumping season
- Conduct sediment sampling at eight locations in the fall of each year.

A quality assurance/quality control program is in place to verify accuracy of monitoring data. The monitoring data are provided to Reclamation to verify full implementation of the pumping and monitoring plan. In addition, monitoring data are provided to USFWS, CDFG, the San Joaquin River Exchange Contractors (SJREC), and Newhall Land and Farming (NLF). Annual monitoring program reports will be provided to Reclamation and the parties to the Settlement Agreement.

ES.5 AFFECTED ENVIRONMENT

Since 1999, the MPG has accumulated and evaluated data on several components of the environment surrounding the Pool, including groundwater level and quality, surface water quality, subsidence, and sediment quality.

GROUNDWATER LEVELS AND SUBSIDENCE

Measured drawdowns available from the water level monitoring program in 1999 through 2002 provide an indication of what is likely to occur in future years. The 2000 drawdowns were quite similar to the 1999 drawdowns in both magnitude and timing. In most of the deep wells, the maximum drawdowns occurred during the peak of the irrigation season (July or August). The MPG pumping program was modified for 2001 and 2002 so that the deep MPG wells did not pump for transfer between July 1 and September 15. In NLF and portions of Farmers Water District (FWD), the maximum drawdowns in 2001 and 2002 still occurred in July but were much smaller than in previous years. West of the Fresno Slough, the maximum drawdowns for the majority of wells in 2001 and 2002 occurred in September and August, respectively. These drawdowns were also considerably smaller than in previous years.

Overdraft has been occurring in portions of western Madera County northeast of Mendota for decades, with many wells south of the Chowchilla area experiencing more than 100 feet of water level decline. Groundwater elevation contour maps of the deep aquifer in the Mendota area produced by DWR (1989-2000) and LSCE and KDSA (2001 and 2002) indicate that groundwater flows into this cone of depression from all directions. This results in lower groundwater levels in the surrounding area, including FWD.

Groundwater flow beneath the San Joaquin River into Madera County is not a natural condition but is induced by pumping in the overdrafted areas. The majority of the groundwater flow into western Madera County comes from the vicinity of the San Joaquin River upstream of Gravelly Ford and beneath the River downstream of Mendota Dam.

GROUNDWATER QUALITY

There has been groundwater quality degradation in the Mendota area for several decades, and water quality is already significantly degraded at some locations. Wells operated by the MPG and other entities including CCID, Firebaugh Canal Water District, and the City of Mendota have been removed previously from service as a result of water quality impacts due to the easterly movement of the saline front. Although the saline front is the primary cause of groundwater quality degradation in the Mendota area, wells operated by Spreckels Sugar Co. have been removed from service due to localized sources of contamination.

Arsenic was detected in 9 of 55 shallow and 6 of 39 deep production or monitoring wells tested in groundwater monitoring programs in the Mendota Pool area. Detected concentrations were generally at, or just above, the detection limit of 2 μg/L. The lowest water quality criteria for arsenic are 5 μg/L for Refuge Surface Water Quality and 10 μg/L for protection of aquatic life. Arsenic was not detected in any MPG production well in the most recent monitoring event at a level exceeding the Refuge Surface Water Quality target level.

Boron was detected in all wells tested. Boron levels in many of the MPG production wells along the Fresno Slough are 0.3 mg/L or higher; and concentrations in 16 wells exceed the CDFG unacceptable level of 0.6 mg/L. However, wells with the highest boron concentrations are either excluded from the proposed action due to high TDS concentrations.

The most recent molybdenum concentrations measured in shallow wells ranged from 1.6 to 58.4 μg/L. The lowest average molybdenum concentration was in the northern Fresno Slough shallow wells, while the highest concentration was observed in a shallow monitoring well west of the Fresno Slough. Molybdenum concentrations in deep wells ranged from 1.8 to 37 μg/L. The lowest water quality criteria for molybdenum are the target levels of 10 μg/L for both Refuge Surface Water Supply and aquatic life protection. Only two of the 23 deep production wells had molybdenum concentrations greater than 10 μg/L. However, 30 of 44 shallow production wells exceeded 10 μg/L molybdenum. The majority of these shallow wells are located in the central and southern Fresno Slough regions. Many of these wells also have high TDS levels and will not be included in the MPG pumping program, or pumping from these wells will be limited.

Selenium was detected in only 3 of 73 samples from shallow or deep MPG production wells along either arm of the Pool in 2001 or 2002. When detected, selenium was present at concentrations between 0.4 μg/L and 1 μg/L.

Surface Water Quality

TDS concentrations in the Pool (either measured directly or estimated from EC data) vary widely, with the highest concentrations seen in samples collected from the southern portion of the Pool. The TDS concentrations are related to the concentrations in the DMC and inputs from the MPG wells.

Design constraints that would be incorporated into each annual pumping program under the proposed action include basing the selection of MPG wells to be pumped each month on water quality criteria and eliminating all pumping from wells with TDS concentrations greater than 2,000 mg/L. During the fall, when water quality at the MWA is most critical, wells with TDS higher than 1,200 mg/L would not be pumped for transfer.

Data collected at nine surface water sampling locations indicate that molybdenum levels in the Pool were 10 μg/L or less. These concentrations are less than the criterion for aquatic life protection of 19 μg/L. However, the highest detected level, 10 μg/L, is at the target level recommended by CDFG for the Mendota Wildlife Area.

Selenium is present at low concentrations in Mendota Pool surface water samples collected in 2001, with the lowest levels seen in samples from the Mendota Wildlife Area, the Lateral 6 & 7 intake, and James ID. The highest selenium levels reported in 2001 were detected in the March and April samples from the northern portion of the Fresno Slough. Detected levels at all locations are an order of magnitude lower than drinking and irrigation water criteria of 50 μg/L.

Sediments

A sediment quality monitoring program in the Mendota Pool was implemented in August 2001. The monitoring program was designed to allow assessment of spatial distribution of selected parameters (EC, arsenic, boron, molybdenum, and selenium) in the sediment. The sampling locations allow estimation of trace analyte inputs from the San Joaquin River, the DMC, and the James Bypass.

Arsenic and boron were detected in all of the October 2001 samples. However, 6 of the 24 boron results were between the method detection limit and the reporting limit. Arsenic ranged from 2.3 mg/kg to 10.9 mg/kg (dry weight). Boron ranged from 5.05 to 40 mg/kg (dry weight). Only 10 of the 24 samples contained molybdenum at concentrations greater than the detection limit of 0.8 mg/kg (dry weight). None of the 10 samples contained molybdenum exceeding 1.8 mg/kg (dry weight). Selenium was not detected in any of the sediment samples, with detection limits ranging from 0.9 mg/kg to 1.2 mg/kg (dry weight).

The sediment quality data from the October 2001 sampling event are statistically analyzed to determine whether they could be associated with MPG pumping. The available data show no indication that the spatial distribution of salinity or trace analytes in the sediment samples is associated with inflow from the MPG wells. Sediments in the San Joaquin River arm of the Pool (i.e., Columbia Canal station) appear to consistently have the lowest trace analyte and salt concentrations, whereas sediments form near the DMC typically have the highest concentrations. Sediment conditions in the southern Pool vary depending on which analyte is being considered.

BIOLOGICAL RESOURCES

Although the project area is highly agricultural, several areas in the project vicinity could support plant and wildlife species. These areas include the Mendota Wildlife Area, the Mendota Pool, and fallowed or idled agricultural lands. The 12,425-acre MWA is the largest publicly owned and managed wetland in the San Joaquin Valley. The refuge is bisected by the Fresno Slough and is adjacent to the 900-acre Alkali Sink Ecological Reserve. The MWA supports approximately 10 to 20 million waterfowl use-days per year, as well as a wide variety of non-game species (Huddleston, 2002).

A list of Federal and State threatened, endangered, proposed listed, candidate, rare, species of concern, and/or species of special concern that may occur in the study area was requested from the USFWS, on August 29, 2001. On October 24, 2001, the USFWS provided a list of protected species in the eleven 7.5-minute USGS quadrangles surrounding the project vicinity. Also, a list of state endangered, threatened, proposed listed, candidate, rare, and species of special concern was obtained from a query of the California Natural Diversity Database (CNDDB) for those same 11 quadrangles. In addition, a letter from W. Loudermilk, Regional Manager San Joaquin Valley and Southern Sierra Region CDFG, dated July 13, 2001, identified protected species in the project vicinity.

Several special-status wildlife species have been recorded at MWA: giant garter snakes, white-faced ibis, Swainson’s hawks, and tricolored blackbirds. Fresno kangaroo rats have been recorded at the adjacent Alkali Sink Ecological Reserve. Palmate-bracted bird’s-beak is a special-status plant that has been recorded at MWA and also occurs at the Alkali Sink Ecological Reserve, along with the rare plants heartscale and Hoover’s eriastrum.

The Mendota Pool is formed by a dam that is owned, operated, and maintained by CCID. The dam backs up water in the Fresno Slough to the James Bypass and in the San Joaquin River almost to San Mateo Avenue. The Mendota Pool is surrounded by areas of intensive agriculture and consequently has limited wildlife habitat value. The margins of the Mendota Pool support some areas of emergent vegetation dominated by cattails and tules; a few cottonwoods and willows grow above the water line. Open water habitat may attract migratory ducks such as mallards, gadwalls, and ruddy ducks. Emergent vegetation provides limited habitat for marsh-dwelling species such as rails, herons, and various songbirds. Several special-status wildlife species have been recorded near the Mendota Pool including giant garter snakes, Swainson’s hawks, yellow-billed cuckoos, and bank swallows (Jones and Stokes 1995). Sanford’s arrowhead is apparently the only special-status plant species that has been recorded near the Mendota Pool (Jones and Stokes 1995).

A variety of row, orchard, and vine crops are produced on agricultural lands in the project vicinity; the proportions represented by different crops vary each year. Similarly, the amount of fallow land varies annually, and may range from 16,340 acres (as in 1984) to 125,082 acres (as in 1991) in WWD. Fallow lands are temporarily removed from production and are a normal part of agricultural processes in the San Joaquin Valley. While it is true that land idled near native habitat may become occupied by threatened or endangered species, it is also true that land is idled or fallowed and subsequently brought back into agricultural production for reasons not related to this action. Fallowed land is routinely disced for weed control, and idled land is usually brought back into production in years when water is abundant.

Numerous special-status wildlife species have been observed near agricultural lands in the project vicinity, including Swainson's hawks, prairie falcons, burrowing owls, San Joaquin antelope squirrels, San Joaquin pocket mice, giant Kangaroo rats, Fresno kangaroo rats, Tipton kangaroo rats, San Joaquin kit foxes, and blunt-nosed leopard lizards (Jones and Stokes 1995). Many of these sightings were made in remnant habitat areas along levees and along the margins of roads and fields.

ES.6 ENVIRONMENTAL CONSEQUENCES

Potential effects on the primary resource areas are closely interrelated. Pumping by the MPG wells and nearby non-project wells would result in a localized lowering of the groundwater levels (drawdown) and the formation of a seasonal "cone of depression" in one or both of the shallow or deep layers of the upper aquifer. These lower groundwater elevations result in increased pumping costs in nearby non-project wells. When the groundwater elevations in the aquifer are depressed, inelastic compaction of the clay layers may occur and result in land subsidence. Drawdown due to pumping would also result in an increase in the hydraulic gradient, thereby increasing the flow of groundwater from outlying areas toward the Mendota Pool. If the outlying areas have poorer water quality than that present near the Mendota Pool, then water quality degradation would occur. Finally, if the groundwater quality is poorer than the surface water quality, then pumping of this water into the Mendota Pool may result in a degradation of the surface water quality, which may ultimately affect biological resources.

GROUNDWATER LEVELS

Analytical groundwater models of the shallow and deep zones have been used since 1999 to predict drawdown and assess short-term impacts of transfer pumping at nearby wells (LSCE and KDSA 2001, 2002). These models are used to predict water level impacts within the study area during each year of the 10-year proposed action.

Drawdowns during the 10-year program are expected to be smaller than in the past, because future MPG deep zone pumping would be less and the deep MPG wells are scheduled to be off for a longer period during the summer. Also, pumping would be distributed over a longer period than during previous pumping programs, thereby resulting in less drawdown. Data collected through 2002 indicate that overdraft is not occurring near the Mendota Pool. If overdraft were to occur due to the project, it would be most apparent in wells near the MPG wells where water level impacts are largest. The Settlement Agreement states that MPG transfer pumping would be reduced if there is evidence that the pumping is causing long-term overdraft.

Of the non-MPG wells, the NLF wells near the San Joaquin River would experience the most drawdown due to the project. Several NLF wells near the River are predicted to experience a maximum of about 25 feet of drawdown due to transfer pumping. This would decrease to about 10 feet for NLF wells located approximately one mile north of the River and to less than 5 feet for most wells east of the Chowchilla Bypass. The residual drawdown (lack of full recovery) that has occurred in several deep wells in NLF near the San Joaquin River since 1999 are partially attributed to MPG pumping. Residual drawdowns in other NLF wells near the northern and eastern boundaries of NLF are caused by pumping within NLF and in the historically overdrafted portions of Madera County (north and east of NLF), rather than by MPG pumping. Residual drawdowns in NLF due to MPG pumping are not anticipated in the future, because transfer pumpage will be reduced considerably to minimize water level and subsidence impacts.

As part of the Settlement Agreement, the MPG agreed to pay compensation to well owners in the SJREC and NLF service areas as mitigation for increased power and other costs incurred due to drawdowns caused by the MPG transfer pumping. With this mitigation, the proposed action would result in less-than-significant short-term economic impacts due to drawdowns in the Mendota area.

SUBSIDENCE

Subsidence occurs in the San Joaquin Valley primarily as a result of inelastic compaction of lacustrine deposits and Coast Range alluvium in the western and southern parts of the Valley due to pumping from the lower aquifer below the Corcoran Clay. Much less compaction occurs in coarser-grain sediments such as the Sierran sands in the eastern half of the Valley. Compaction in the Sierran sands is primarily elastic and is much less likely to cause irreversible subsidence.

Subsistence is monitored at the Yearout Ranch and Fordel extensomenters. In the Phase II report (KDSA and LSCE 2000b), a subsidence threshold of an average of 0.005 foot per year at the Yearout Ranch extensometer was identified (0.05 foot over 10 years). This criterion was selected for three reasons: 1) it is the minimum subsidence that could be detected over the given period, 2) the Yearout Ranch extensometer is located near FWD and Spreckels Sugar Co. in an area that has historically experienced relatively large drawdowns, and 3) the Yearout Ranch extensometer has a relatively long dataset with which to compare current and historic subsidence rates. This criterion is also applied to compaction measured at the Fordel extensometer west of the Fresno Slough.

In the Mendota area, historical compaction data indicate that compaction in the Sierran sands above the Corcoran Clay is primarily elastic. The amount of subsidence attributed to MPG transfer pumping at the Yearout Ranch extensometer in 2000 was 0.0045 foot. The amount of subsidence at the Yearout Ranch extensometer attributed to MPG transfer pumping in 2001 was about 0.01 foot. Because transfer pumpage would be reduced as necessary to ensure less than 0.05 foot of total subsidence over the 10-year period, the proposed action would result in less–than-significant subsidence in the Mendota Area.

GROUNDWATER QUALITY

MPG pumping as specified in the proposed action would contribute to groundwater quality degradation primarily as a result of the following three factors:

1. Pumping of MPG wells along the Fresno Slough (especially deep wells) would create a steeper horizontal gradient, which would accelerate lateral flow of groundwater west of the Slough toward the MPG well field. The northeasterly gradient exists both with and without MPG pumping, however the pumping steepens the gradient and increases the rate of flow from the west and southwest.

2. Pumping of deep MPG wells along the Fresno Slough would increase vertical (downward) gradients. This would accelerate the downward flow of groundwater through the A-clay to the deeper water-bearing zones of the upper aquifer system. Near both branches of the Pool, the quality of the shallow groundwater is good due to recharge from the Pool. In areas west of the Slough, however, the quality of the shallow groundwater is poor, and this downward flow increases water quality degradation below the A-clay.

3. Pumping of MPG wells (especially shallow wells along Fresno Slough) removes some of the good quality groundwater that originates as seepage from the Pool. In the absence of MPG pumping, the seepage from the Pool would help maintain water levels in the shallow, unconfined aquifer above the A-clay, improve groundwater quality near the Pool, and counteract some of the degradation caused by lateral flow of lower quality groundwater from the west.

Deep zone transfer pumping would be conducted primarily in the spring and fall so as not to increase the maximum drawdown in the area, which typically occurs during the peak of the irrigation season (July or August). The effect of this action would be to mitigate increases in the horizontal and vertical gradients in the deep zone, which would slow the rate of salinity increases in the groundwater.

An increased rate of groundwater quality degradation due to the proposed action was predicted at all MPG wells along the Fresno Slough with the groundwater quality model. The model results show a predicted average annual TDS increase over the 10-year period due to the regional gradient, non-transfer pumpage, and transfer pumpage. At the start of the 10-year simulation, 66 wells were included in the MPG pumping programs for transfer or adjacent use. Over the future 10-year project period, only one additional well was removed from the pumping program because it was predicted to exceed the TDS constraint of 2,000 mg/L. Estimated pumpage from other wells was reduced, especially during the fall, to maintain surface water quality. The effects of the pumping program on groundwater quality at non-MPG wells were indicated primarily in deep wells west of Fresno Slough. The average predicted annual TDS increase due to transfer pumpage at the shallow MPG wells ranges from 13 to 43 mg/L, and for all wells the annual average was 27 mg/L per year. Wells in the southern half of the MPG well field along the Fresno Slough generally had higher degradation rates than wells located further north.

SURFACE WATER QUALITY

The proposed action includes several design constraints that limit impacts to surface water quality. The planned quantity and quality of groundwater pumped into the Pool would be adjusted during each year of the proposed action to ensure that the surface water quality criteria for salinity and trace elements (arsenic, boron, molybdenum, and selenium) would be met. The surface water mixing models would be used in conjunction with analytical results from groundwater samples to facilitate the decision making process regarding annual adjustments to the pumping program. The surface water mixing models would be updated each year as new surface and groundwater data are obtained, and the pumping program would be adjusted to minimize salinity impacts. Selection of the wells to be pumped for transfer each year would be based on groundwater quality in order to limit the total mass of salt and trace analytes introduced into the Pool. The measured water quality of the DMC and the San Joaquin River used in the mixing models would be updated as appropriate. By updating the models as new surface water and groundwater data become available, the MPG annual pumping program would protect water quality at the MWA and northern portion of Mendota Pool throughout the 10-year duration of the proposed action.

The water quality in the northern Fresno Slough is primarily influenced by the quality of the water that is introduced by the DMC. Design constraints have been implemented to preclude the MPG wells along the Fresno Slough from influencing water quality in the northern Slough.

The predicted effect of the proposed action and the cumulative effect during the first pumping year (Year 2 of the project) and the final (tenth) year on TDS concentrations was modeled as part of this analysis. These results account for the predicted groundwater quality degradation and associated modifications to the pumping program. The model indicates that transfer pumpage would result in an average TDS increase in surface waters during the pumping months of 96 mg/L in Year 2 and 109 mg/L in Year 10 of the proposed action.

Boron was detected in all wells tested. The average boron concentration of MPG wells along the Fresno Slough included in the transfer pumping program is 0.4 mg/L, which is slightly higher on average than the concentrations in the DMC inflow. The results of the surface water mixing model for boron indicate that MPG transfer pumpage would result in an average boron concentration increase of 0.04 mg/L during months when pumping would occur (March through November).

Because the concentrations of arsenic and selenium are typically below detection limits in MPG wells, the proposed pumping program will not adversely affect surface water quality with respect to these constituents. Molybdenum concentrations in all MPG wells included in the transfer pumping program are below the lowest applicable water quality criterion of 10 μg/L. Therefore, the pumping program will not result in exceedances of surface water quality criteria for molybdenum.

The pumping program design constraints and adaptive management measures would effectively mitigate the effect of the proposed action on surface water quality in Mendota Pool. The surface water mixing models would be updated annually with the most recent data from the groundwater and surface water monitoring programs to design annual pumping programs that would not have a significant effect on beneficial uses of Mendota Pool water. Assuming that water from the DMC is of comparable quality to that of recent years, the model results would indicate whether the proposed pumping program for each year would meet surface water criteria for irrigation use, protection of aquatic life, and refuge water supply. The pumping program (i.e., specification of wells to be pumped for both transfer and adjacent use during each month and the volumes to be pumped) would be adjusted if the model results indicate exceedance of water quality criteria. The small quantity of MPG water that would flow north out of the Mendota Pool and into the San Joaquin River would be pumped into the Pool by the FWD wells. On average, these wells have slightly lower TDS and boron concentrations than water from the DMC. Therefore, the proposed action would not add to the salt and boron loads in the River below Mendota Dam.

SEDIMENT QUALITY

Sediment quality criteria for arsenic and selenium are not exceeded in Pool sediments. Corresponding criteria are not available for boron, molybdenum, or salts (TDS or EC). Sediment quality data from October 2001 and 2002 indicate that arsenic, boron, and EC are generally highest near the outfall from the DMC and lowest in the San Joaquin arm. No consistent pattern in the concentration of trace analytes is evident in other portions of the Pool.

The MPG production wells are not currently contributing elevated concentrations of arsenic, molybdenum, or selenium to surface waters in the Pool. Therefore, it is unlikely that MPG inputs would increase concentrations of these analytes in the sediments. Boron is present in groundwater at concentrations near the lowest applicable water quality criterion. Modeling does not indicate that MPG pumping would result in exceedance of water quality criteria for boron in surface water in the Pool. Salts are added to surface water in the Pool from groundwater. However, as the salts are highly soluble, it is unlikely that they would accumulate in the sediments.

None of the available lines of evidence suggest that MPG pumping has contributed, or would contribute, to accumulation of salts and trace analytes in the sediments. Maintenance of surface water quality would serve to maintain sediment quality.

BIOLOGICAL RESOURCES

The potential effects of the proposed project on biological resources were evaluated relative to habitat modification, irrigation water quality, and aquatic toxicity. The pumping project may decrease the amount of fallowed land (agricultural land that has been disced, irrigated, mowed or otherwise manipulated to control weeds) over the no action alternatives. Practices used to maintain fallowed land generally reduce the growth of vegetation, which reduces the amount of potential cover from predators and severely limits the habitat value of fallowed land for species such as the San Joaquin antelope squirrel, giant kangaroo rat, and burrowing owl. Therefore, biological impacts (habitat modification) on terrestrial species present on fallowed lands are not expected to occur.

The sodium adsorption ratio (SAR) is an indication of the potential for irrigation water to increase salt loading in the soils to which it is applied. The evaluation of the SAR in conjunction with measured salinity indicates that surface waters in the Pool are currently slightly to moderately impaired for irrigation use. The proposed action would increase salinity in the Pool above that in the DMC, but would maintain the salinity in the Pool below water quality criteria. The water quality would continue to be acceptable for agricultural uses.

It is unlikely that plants and wildlife in the Pool or the MWA, including special-status species, would be exposed to concentrations resulting in significant bioaccumulation of selenium or toxicity of arsenic, molybdenum, or boron in surface water as a result of the proposed action. Selenium and arsenic concentrations have been consistently below detection limits in groundwater samples. Molybdenum in groundwater is consistently below applicable water quality criteria. Although boron in groundwater exceeds the CDFG target concentration for refuge water supplies, no exceedances of the "unacceptable" level have been detected in surface waters of the Pool. The proposed project will not result in exceedances of the CDFG unacceptable level.

There are no indications that the proposed action would result in sediment quality criteria for selenium or arsenic being exceeded during the 10-year program. Analysis of the recent sediment data indicated that selenium concentrations did not exceed the 2 mg/kg (dry weight) criterion, with detection limits ranging from 0.9 to 1.2 mg/kg (dry weight).

It is unlikely that special-status plants and wildlife in the Pool or the Mendota Wildlife Area would be exposed to concentrations resulting in significant bioaccumulation of selenium or toxicity of arsenic, molybdenum, or boron in surface water as a result of the proposed action. The cumulative effects of the pumping program on biological resources, including special-status species like the giant garter snake, in the Pool or MWA are considered to be less-than-significant because:

- Selenium and other constituents (arsenic, boron, and molybdenum) in surface water and in pumping wells do not exceed target values set by the USEPA and the USFWS.
- Increases in TDS concentrations in the Pool are minimized to target levels through application of design criteria.
- Introduction of groundwater from MPG production wells to the Pool does not reduce sediment quality.
- Potentially toxic concentrations of salts and trace elements will not be present in surface waters or sediments.

Because concentrations of some constituents (i.e., boron and salts) will increase in surface waters due to the proposed action but would remain below applicable water quality criteria, the proposed action may affect but is not likely to adversely affect special status species.

CENTRAL VALLEY PROJECT OPERATIONS

The MPG pumping program would not result in exceedance of either the available capacity in the SLC or the storage in the SLR. The MPG would not affect the availability of project or preference power to other users. Therefore, the proposed action would not have a significant effect on Central Valley Project operations.

ARCHAEOLOGICAL AND CULTURAL RESOURCES

Indian Trust Assets are legal interests in property or rights held in trust by the United States for Indian Tribes or individual Native Americans. The distribution of Indian reservations, rancherias, and public domain allotments throughout the project area was reviewed. No Indian lands of any type were found within the study area. There are no significant effects. There are no effects on archaeological or cultural resources for the action and any alternative.

LAND USE AND TRAFFIC

The proposed action does not propose any change to or conflict with current land use designations or zoning and would have no effect on land use. The proposed action does not propose any change to local or regional traffic circulation and would have no effect on the transportation in the project area.

AIR QUALITY

Assuming there is no change in farming operations and that existing pumps are electric, the Proposed action would have no effect on air quality.

NOISE

Groundwater pumping by the MPG would increase to make-up for water needs not delivered by CVP. Their proposed locations would remain within agricultural areas and not in proximity to sensitive receptors. Therefore, there would be no effect on noise.

ENVIRONMENTAL JUSTICE

Without the exchanged water, some field crops may not be planted or may become stressed, which could lower production. The proposed action would help maintain agricultural production and local employment, and would therefore result in a net benefit to the local population. The Land Fallowing alternative may result in reduction of the work force due to removal of lands from agricultural production.

SOCIOECONOMIC EFFECTS

Agriculture is a very important industry in Fresno and Madera counties. Agriculture takes on additional significance because it is generally considered a “primary” industry (along with mining and manufacturing). Changes in primary industry activity, therefore, usually precipitate additional changes in non-primary, or support, industries. The proposed action would help maintain current levels of employment.

SUMMARY

The proposed action would achieve the goals of the pumping program by providing supplemental water resources at a cost-effective rate. The proposed action is anticipated to have less-than-significant effects on the majority of resource areas considered in this analysis. The primary adverse effect of the proposed action is to increase the cumulative rate of groundwater degradation in wells west of the Pool. These wells are primarily MPG wells. This degradation of groundwater quality is not anticipated to be translated to a significant effect on surface water quality because of the adaptive management of surface water quality through the use of modeling to forecast potential effects thereby allowing the annual pumping program to be adjusted prior to the start of the pumping season.

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LIST OF FIGURES

AAQS	Ambient Air Quality Standards
As	Arsenic
AWQC	Ambient Water Quality Criteria
B	Boron
CCID	Central California Irrigation District
CDFG	California Department of Fish and Game
CEC	Categorical Exclusion Checklist
CEQA	California Environmental Quality Act
cfs	Cubic feet per second
CIMIS	California Irrigation Management Information System
CNDDB	California Natural Diversity Database
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CVRWQCB	Central Valley Regional Water Quality Control Board
dBA	Decibels
DMC	Delta-Mendota Canal
DWR	Department of Water Resources (California)
EA	Environmental Assessment
EC	Electrical Conductivity
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERL	Effects Range/Low
ESA	Endangered Species Act (federal)
ET_0	Reference Evaporation Rates
FCWD	Firebaugh Canal Water District
FEIR	Final Environmental Impact Report
FONSI	Finding of No Significant Impact
FWD	Farmers Water District
JID	James Irrigation District
Jones and Stokes	Jones and Stokes Associates, Inc.
KDSA	Kenneth D. Schmidt and Associates
L_{dn}	Average day/night sound level
L_{eq}	Equivalent sound level
LSCE	Luhdorff and Scalmanini, Consulting Engineers
µg/L	micrograms per Liter
mg/kg	milligram per kilogram
mg/L	milligrams per Liter
Mo	Molybdenum
MPG	Mendota Pool Group
MWA	Mendota Wildlife Area
NEPA	National Environmental Policy Act
NLF	Newhall Land and Farming

NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NOP	Notice of Preparation (of EIR)
Reclamation	U.S. Bureau of Reclamation
RWQCB	Regional Water Quality Control Board
SAR	Sodium Absorption Ratio
Se	Selenium
Settlement Agreement	Settlement Agreement for Mendota Pool Transfer Pumping Project
SJREC	San Joaquin River Exchange Contractors
SLC	San Luis Canal
SLR	San Luis Reservoir
SLWD	San Luis Water District
SLDMWA	San Luis and Delta-Mendota Water Authority
SWP	State Water Project
TDS	Total Dissolved Solids
TID	Tranquillity Irrigation District
TOC	Total Organic Carbon
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WRCC	Western Regional Climate Center
WWD	Westlands Water District

This environmental impact statement (EIS) evaluates the proposed exchange of up to 25,000 acre-feet of water per year over a 10-year period between the U.S. Bureau of Reclamation (Reclamation) and the farmers comprising an unincorporated association known as the Mendota Pool Group (MPG). The MPG owns property and groundwater wells in the vicinity of the Mendota Pool in western Fresno County (Figure 1-1). A list of the current members of the MPG is provided in Appendix A.

The MPG proposes to pump non-Central Valley Project groundwater from their wells into the Mendota Pool and exchange it with water from the Central Valley Project (CVP), which is administered by Reclamation. This exchanged water will be delivered to land owned by MPG members elsewhere within the CVP service area. The project is needed to make up for shortfalls in the contracted amounts of water delivered via the CVP.

1.1 NEED FOR THE ACTION

Reclamation's purpose in authorizing this action is to facilitate the efficient delivery and re-allocation of water to facilitate environmental and economic benefits as authorized by 34 U.S.C. §3408(d), Central Valley Project Improvement Act (CVPIA). The need for the proposed authorization is to facilitate improvements in the reliability of irrigation water delivery to the San Luis Canal (SLC) [at Check 13 on the Delta Mendota Canal (DMC)] without affecting CVP water deliveries at Mendota Pool. The proposed action will offset cutbacks in CVP irrigation water supplies as a more balanced distribution of water among competing uses is sought.

Since 1989, water supplies to CVP agricultural users have been drastically reduced in a mandatory effort to balance competing non-agricultural benefits of the CVP. Between 1980 and 1989, water deliveries to Wetlands Water District (WWD) averaged 103% of the District's entitlements (Table 1-1). However, since that time deliveries have averaged 63.8%. Full water allocations (> 90%) were only provided during 1995 through 1998, which were hydrologically wet years. This reduction in water deliveries from the CVP has required that agricultural users obtain a large portion of their water requirements from supplemental sources such as groundwater.

MPG members own approximately 50,000 acres of historically irrigated farmland in WWD and San Luis Water District (SLWD) (Figure 1-2). These lands are not adjacent to the Pool and depend on deliveries from the SLC (California Aqueduct) to WWD and SLWD for irrigation water. There are no other supplemental sources of surface water that can be used for these lands.

WWD has taken numerous steps to obtain additional sources of irrigation water and to ensure that comprehensive water conservation practices are being followed (WWD 2001). Similarly, SLWD has instituted water conservation actions. Nevertheless, water supplies are still inadequate to provide reliable and cost-effective irrigation water to historically irrigated lands within WWD's service area. The MPG members need to supplement their water deliveries with affordable water in order to maintain production on historically irrigated lands.

Groundwater has long been an important water source for farmers within the WWD and SLWD service area. Prior to the construction of the CVP in 1963, groundwater was the primary source of irrigation water (WWD 1999). To make up for the shortfall in surface irrigation water since 1989, landowners and water users within the districts have drilled wells to obtain supplemental water. In 1990, WWD adopted a short-term program of groundwater conveyance through the Mendota Pool for emergency relief. It adopted similar programs in 1991, 1992, 1993, and 1994.

1.2 PROJECT OBJECTIVES

The objective of the proposed project is to enable the MPG to maintain production on historically irrigated lands (Figure 1-2) by obtaining sufficient water at cost-effective prices to offset cutbacks in CVP deliveries. The project is not intended to increase the amount of water for farming activities but would replace water allocated for other CVP purposes. This program would enable project participants to:

Replace water no longer available because of restrictions on the export of water from the Delta.

Deliver water to farms for an average cost that approximates the cost of contract water and does not exceed the costs of supplemental water on the open market.

Maintain production on lands with long-term water supply contracts that have regularly produced agricultural commodities.

1.3 SCOPE OF THIS ENVIRONMENTAL IMPACT STATEMENT

This EIS analyzes the environmental effects of the 10-year proposed project and two no action alternatives on the quantity and quality of groundwater and surface water resources in the Mendota area and WWD and SLWD, and surface water resources delivered to users via the Mendota Pool. The proposed project and alternatives are described in detail in Section 2. This EIS is based on the analyses presented in the Phase I and Phase II technical reports (KDSA and LSCE 2000a,b), the 2000 Annual Report (LSCE & KDSA 2001) and the 2001 monitoring program.

1.3.1 BACKGROUND

The farms owned or operated by MPG members lie within WWD and SLWD, which are located on the west side of the San Joaquin Valley. These districts receive water from the CVP through the DMC and the SLC, both of which are administered by Reclamation. Water from the CVP is delivered directly to farmlands or stored temporarily in San Luis Reservoir (SLR) for later delivery.

1.3.1.1 Historical Water Supply to WWD

WWD has water service contracts with Reclamation to receive 1.15 million acre-feet per year of water from the CVP. The water is used to irrigate lands in Priority Areas I and II of the WWD service area. The WWD water supply consists of 900,000 acre-feet per year of water under a 1963 contract with Reclamation and 250,000 acre-feet per year of provisional supply. The provisional supply resulted from the judgment in the Barcellos lawsuit, which reaffirmed the validity of the 1963 contract and directed the federal government to provide 250,000 acre-feet per year at cost-of-service rates.

Prior to 1988, irrigation needs in the WWD were satisfied by the water that Reclamation delivered from the Sacramento-San Joaquin River Delta, as well as by water transfers and groundwater extracted by farmers for use on their own lands. However, between 1988 and 2000, several regulatory decisions, such as the biological opinions for winter-run Chinook salmon and Delta smelt, have imposed conditions on exports from the Delta and have influenced reservoir storage and supply operations, thereby reducing the water available from the Delta and SLR (Table 1-1). As a result, future allocations from the CVP have become more uncertain. The future WWD water supply depends on the allocation of contract water from Reclamation.

Total exports from the Delta have been reduced from an average of 3.3 million acre-feet per year prior to 1988 to an average of 2.5 million acre-feet per year after 1988, or a reduction of approximately 25% (L. Johnson 2001, pers. comm.). However, these reductions are not apportioned equally among all users. Currently, allocation of CVP water follows a hierarchical structure in which agricultural water service contractors (e.g., WWD) are provided water only after all other obligations (approximately 1.5 million acre-feet) are met. As a result, cutbacks in water availability primarily affect agricultural water service contractors, while other users receive their full allocation. For example, 1993 was hydrologically an above normal year with rainfall at 150% of normal, yet Reclamation allocated only 50% of the contracted water to WWD (Table 1-1). Runoff in 1994 was about 50% of normal, but Reclamation only allocated about 490,000 acre-feet of contracted supplies to WWD, or about 43% of its CVP allocation.

Estimates of future federal water supply range from 0% to as much as 80% of WWD's contracted amounts of 1.15-million acre-feet per year, depending on precipitation and export constraints from the Delta. Assuming that WWD had access to a long-term average of 60% of the maximum water supply or 690,000 acre-feet per year, and had a sustainable groundwater yield of 200,000 acre-feet per year, the District would still be approximately 260,000 acre-feet per year short of the 1.15 million acre-feet per year specified in its water service contract.

Even at the full contract amount, WWD supplies would still be inadequate to maintain production, and District water users would require supplemental irrigation water supplies. If a suitable source of supplemental water is not found, currently farmed lands would have to be removed from production, or planted with crops with lower water requirements. As noted above, farmers within the WWD service area have relied on groundwater since the late

1980's to make up for the shortfall in surface water. Pumpage by the MPG since 1997 is shown in Table 1-2, as well as the volume exchanged with Reclamation each year.

1.3.1.2 History of Planning

The project evaluated in this EIS has evolved over an extended period since the early 1990's. This section describes the development of the proposed project starting with the initial efforts to develop a long-term solution to reductions in water deliveries. Numerous changes in the scope and duration of the program have been made since a groundwater pumping program was originally conceived. In 1995, the MPG and WWD completed a draft Environmental Impact Report (EIR) entitled "Conveyance of Nonproject Groundwater from the Mendota Pool Area Using the California Aqueduct" (Jones and Stokes 1995); and in December 1998, a Final Environmental Impact Report (FEIR) was completed (Jones and Stokes and LSCE 1998). The FEIR outlined a mitigated project which would allow the MPG to pump up to a total of 620,000 acre-feet over a 20-year period for transfer to WWD, or an average of 31,000 acre-feet per year.

After the FEIR was certified by WWD (the lead agency for the project), the San Joaquin River Exchange Contractors Water Authority (SJREC) and Newhall Land and Farming (NLF) filed a lawsuit against WWD and the MPG alleging that the FEIR failed to comply with the requirements of the California Environmental Quality Act (CEQA). The SJREC also filed a lawsuit against the MPG and others alleging that MPG pumping created a nuisance for the SJREC. The SJREC is a group of four water districts and companies located primarily north of Mendota; these are the Central California Irrigation District (CCID), the Firebaugh Canal Water District (FCWD), the Columbia Canal Company, and the San Luis Canal Company (Figure 1-3). NLF operates the 12,500-acre New Columbia Ranch north of the San Joaquin River.

During the spring of 1999, representatives from the SJREC and NLF met with representatives from the MPG and agreed to delay the lawsuits pending the results of a test pumping and monitoring program conducted in 1999 to determine the impacts of MPG transfer pumping on the SJREC and NLF. The results of these discussions were formalized in the "Settlement Agreement for the Mendota Pool Transfer Pumping Program" (see Section 1.3.3.2). The test pumping and monitoring program was conducted jointly by Luhdorff and Scalmanini Consulting Engineers (LSCE) of Woodland, consultants to the MPG, and Kenneth D. Schmidt and Associates (KDSA) of Fresno, consultants to the SJREC and NLF. In addition to determining the impacts of the proposed MPG transfer pumping, the consultants were to make recommendations for mitigation measures to reduce these impacts as appropriate. The initial study involved a test-pumping period during 1999 when the MPG wells were pumped at approximately the same rate as proposed in the FEIR for a normal year. Monitoring of groundwater levels, surface water quality, and compaction was conducted prior to, during, and after this test-pumping period. Groundwater sampling was also conducted during the test-pumping period. The monitoring program was designed to allow determination of the following potential impacts of pumping the MPG wells:

- Water level declines in other wells in the area, especially the NLF wells, and other wells along the San Joaquin River branch of the Pool.

- Groundwater quality changes.
- Changes in surface water quality at the SJREC intakes from the Mendota Pool.
- Land surface subsidence.

During the history of this project, several different pumping programs were proposed and evaluated. A summary of the different proposed pumping programs is provided in Table 1-3.

After the impact analysis for the 1999 transfer pumping program (KDSA and LSCE 2000 a,b) was complete, modifications were made to the program in 2000 to reduce these impacts. Transfer pumping in 2000 was conducted from June 6 to October 31, and included both exchanges with Reclamation and trade with other users. Approximately 19,000 acre-feet were pumped during this period, of which about 7,200 acre-feet were exchanged with Reclamation (Table 1-2).

Additional modifications were made to the MPG transfer pumping program for 2001 to further reduce impacts. These included shutting off the deep wells between July 1 and September 15 to reduce deep zone drawdowns and selecting wells to be pumped during the fall months based on water quality criteria. Transfer pumping in 2001 occurred between May 1 and November 20. Approximately 27,400 acre-feet were pumped during this period, of which 16,400 acre-feet were exchanged with Reclamation.

Improved planning tools, including surface water mixing models, were developed based on the results of the 2000 and 2001 monitoring programs. These tools were used to design the transfer pumping program for 2002, and will be used in the development of all subsequent programs.

The design of the 2000 transfer pumping program focused on reducing the potential impacts due to groundwater drawdowns and salinity increases in surface water in the northern portion of the Pool. During the development of the 2001 pumping program, the potential impacts due to selenium concentrations in groundwater and salinity increases in surface water in the southern portion of the Pool were also incorporated into the analysis. A sediment sampling program was also implemented during the 2001 pumping program.

1.3.2 Summary of Scoping Process

As part of the preparation of the environmental documentation for the 2001 and 2002 transfer pumping programs, Reclamation and the MPG entered into discussions with interested parties including the SJREC, NLF, California Department of Fish and Game (CDFG), the Regional Water Quality Control Board (RWQCB), and U. S. Fish and Wildlife Service (USFWS). The pumping programs and related environmental documents were reviewed by these entities and the public prior to being finalized. Monitoring data have been provided to SJREC, NLF, CDFG, and USFWS.

Prior to the initiation of the preparation of this EIS, a series of letters were sent out to 28 interested parties and State and Federal agencies asking for input into the EIS planning process. A Notice of Intent (NOI) to prepare the EIS was published in the Federal Register on January 3, 2002. Concurrently, a notice was placed in the “Public Notices” section of the Fresno Bee (the local newspaper) summarizing the NOI, and requesting input from the public. A Public Scoping Meeting was held on January 14 at the Mendota City Council Chambers. 33 persons attended this meeting. Written comments on the scope of the EIS were received and accepted through January 28. 13 comment letters were received. A summary report on the scoping process was prepared and submitted to Reclamation (ENTRIX 2002b).

1.3.3 RELATED ENVIRONMENTAL DOCUMENTS

The following environmental documents and studies were prepared as part of the evaluation of the FEIR and subsequent pumping programs.

1.3.3.1 EIR for WWD

WWD published a Notice of Preparation (NOP) on August 24, 1994 describing the intent of the original project. To continue the conveyance program as a long-term solution to managing water supplies, the Department of Water Resources (DWR) requested that WWD prepare an EIR on the effects of the project. DWR legal and technical staff assisted in determining the scope of the EIR. Eleven comment letters were received during the NOP process.

Based on the initial study responses and comments generated during the NOP process, the EIR focused on three key technical areas: (1) groundwater resources, including subsidence issues, water levels, groundwater quality, and groundwater overdraft; (2) surface water quality; and (3) biological resources. The draft EIR (Jones and Stokes 1995) for this project was submitted for public review in October 1995. The draft EIR described the proposed project and five project alternatives.

The Final EIR (Jones and Stokes and LSCE 1998) was released in December 1998. Based on comments received on the draft EIR, the Final EIR identified three mitigation measures:

F-1 Reduce transfer pumpage to an average of 31,000 acre-feet per year

F-2 Maintain water quality at Exchange Contractors’ intakes

F-3 No introduction of groundwater into the California Aqueduct

1.3.3.2 Settlement Agreement

Subsequent to the release of the Final EIR and the decision to proceed with the project, the SJREC and the NLF filed suit in California Superior Court to stop implementation of the project. Representatives of SJREC and NLF met with the MPG to develop a mutually agreeable alternative to the pumping program in the Final EIR. The “Settlement Agreement for Mendota Pool Transfer Pumping Project” describes the agreed upon pumping program and mitigation measures and incorporates the findings of the Phase I and Phase II technical reports described below.

The Settlement Agreement outlined a 10-year pumping program. The 10-year program assumed that MPG transfer pumping would vary from year to year depending on whether the year was classified as normal, wet, or dry. The MPG would determine the classification of each year before the start of each irrigation season based on the expected level of surface water deliveries. If the MPG pumped the maximum allowable under the Settlement Agreement, the total quantity of water to be pumped would average 27,000 acre-feet per year over a 10-year period. The pumping program for 10-year period is based on six "normal" years during which up to 31,600 acre-feet would be pumped for transfer, two "dry" years during which transfer pumping could increase to 40,000 acre-feet per year, and two "wet" years when no transfer pumping would occur. Pumping of up to 14,000 acre-feet of water per year would be allowed for use on MPG lands adjacent to the Pool (Figure 1-4). If pumping for adjacent use exceeds 14,000 acre-feet in any year, the volume of transfer pumping would be reduced accordingly.

The 10-year program would limit deep zone pumping to a maximum of 12,000 acre-feet per year, because groundwater level and subsidence impacts are considered to be due almost entirely to pumping below the A-clay layer. The MPG would be able to make up for some of the deep zone pumpage reductions by increasing pumpage above the A-clay. The Settlement Agreement defined a series of pumping program design constraints to minimize effects to the SJREC and NLF. In addition, the Settlement Agreement specified that an annual monitoring program be conducted and that annual reports be submitted to the parties to the agreement. As described in Appendix B, the annual monitoring reports will be submitted to Reclamation for their review.

1.3.3.3 1999 Test Pumping Program

As a result of the legal challenges to the Final EIR, a joint study was initiated in 1999 to determine the impacts of proposed MPG pumping on the SJREC and NLF. The 1999 test program consisted of two MPG pumping periods (July 19 to October 1 and November 1 to 16). Monitoring of water levels, water quality, and subsidence was conducted before, during, and after these pumping periods. This test-pumping program resulted in the preparation of the following reports:

- Results of 1999 Test Pumping Program for MPG Wells (Phase I report; KDSA and LSCE 2000a)
- Long-Term Impacts of Transfer Pumping by the MPG (Phase II report; KDSA and LSCE 2000b)

The Phase II report contains recommended mitigation measures to reduce the impacts observed in 1999 and modifications to the MPG monitoring program initiated in 1999. Some of these measures were incorporated into the 2000 pumping program, which was conducted while negotiations proceeded with the SJREC and NLF on a long-term agreement. These reports and subsequent negotiations resulted in the development of the 2001 pumping program for the MPG.

1.3.3.4 2000 Test Pumping and Transfer Pumping Program

A transfer pumping program was conducted during the summer and fall of 2000 to provide supplemental water for MPG crops and to collect additional data on the impacts of the MPG pumping. The data collected in 2000 were used along with the 1999 data to develop a long-term plan for MPG pumping that did not have significant impacts on the SJREC or NLF. The summer test pumping program was authorized under a Categorical Exclusion Checklist (CEC), and the MPG received credit for water pumped into the Pool between June 6 and July 21. Water pumped between August 1 and September 19 was conveyed to WWD via Lateral 6 or traded with other water districts near the Pool. An exchange agreement with Reclamation was needed in the fall so that the MPG could receive credit for water pumped after September 19. In November 2000, Reclamation issued a Finding of No Significant Impact (FONSI) that allowed the MPG to pump for a three-and-a-half-month period (September 19, 2000 to January 1, 2001) while the monitoring program and negotiations between the parties continued. Reclamation provided water to the MPG at Check 13 of the DMC. The actual fall transfer pumping period ended on October 31, 2000. The results of the 2000 monitoring program are presented in the "Mendota Pool Group Pumping and Monitoring Program: 2000 Annual Report" (LSCE and KDSA 2001).

1.3.3.5 2001 Transfer Pumping Program

The 2001 transfer pumping program was the subject of the "Environmental Assessment for the Mendota Pool 2001 Exchange Agreement" (EA) prepared by Reclamation and finalized in August 2001. The program was based on negotiations utilizing the results of the 1999 and 2000 test-pumping programs. The EA for the 2001 pumping program included a monitoring program for groundwater levels, groundwater and surface water quality, sediment quality, and subsidence. The results of the 2001 monitoring program are presented in the "Mendota Pool Group Pumping and Monitoring Program: 2001 Annual Report" (LSCE and KDSA 2002). Relevant data from this monitoring program are included in this EIS.

1.3.3.6 2002 Transfer Pumping Program

The 2002 transfer pumping program was the subject of the "Environmental Assessment (EA Number 01-83) for the Mendota Pool 2002 Exchange Agreements" prepared by Reclamation and finalized in May 2002. The program was based on the results of the 1999, 2000, and 2001 transfer pumping programs. Improved predictive models for groundwater drawdown and surface water quality were developed and used to predict effects of the pumping program. The EA for the 2002 pumping program included a monitoring program for groundwater levels, groundwater and surface water quality, sediment quality, and subsidence. Available data from this monitoring program are presented in this EIS.

1.3.4 Issues Studied in Detail

Identification of the issues to be studied in detail in this EIS was based on the results in the 1998 FEIR, the Settlement Agreement, the Phase I and Phase II reports, the EAs for the 2001 and 2002 pumping programs, and evaluation of environmental data collected as part of the 1999 through 2001 monitoring programs.

1.3.4.1 Potential Effects

Five primary resource areas were identified in previous environmental documents: groundwater levels, land subsidence, groundwater quality, surface water quality, and biological resources. This EIS addresses those five resource areas and includes an evaluation of potential impacts to sediments, and historical and societal resources. Resource areas evaluated in this EIS for potential impacts include:

- Groundwater levels
- Land subsidence
- Groundwater quality
- Surface water quality
- Sediment quality
- Biological resources
- Central Valley Project operations
- Land use
- Air quality
- Noise

1.3.4.2 Area of Interest

The primary area of interest for this EIS includes portions of western Fresno County and southwestern Madera County. Because the No Action alternatives would take place in WWD and SLWD, these regions are also considered relative to the No Action alternatives. The area of interest for the evaluation of potential effects is dependent on which primary environmental issue of concern is being addressed and which project alternative is being evaluated: the proposed project, the alternative project, or the no action alternatives. This EIS evaluates project-related groundwater impacts within at least a 6-mile radius of Farmers Water District (FWD), which is the center of deep zone drawdowns caused by MPG transfer pumping (Figure 1-5). Specific areas of interest include the Mendota Pool and associated canals and surface water bodies, areas potentially affected by groundwater pumping, lands irrigated by the MPG, and nearby communities in which the landowners and workers live. Data from recent monitoring programs have provided information with which to assess the magnitude of the potential effects and to define the areas likely to be affected. Additional areas in WWD and SLWD are also included for evaluation of impacts due to the No Project alternatives.

1.4 REQUIRED DECISIONS

The National Environmental Policy Act (NEPA) requires federal agencies to analyze the potential environmental impacts of proposed actions and alternatives to decide on whether to proceed with the proposed project or an alternative. This EIS is intended to provide the information required by Reclamation to select between the alternative projects based on a consideration of their effects on the groundwater, surface water, sediment, biological, and socioeconomic resources in the vicinity of the Mendota Pool.

1.4.1 APPLICABLE REGULATORY REQUIREMENTS AND REQUIRED COORDINATION

Reclamation is the lead federal agency in the preparation of this EIS. The proposed project will not require any State permits to be implemented. The federal action contemplated in this EIS has the potential to affect federally protected species. The federal ESA requires Reclamation to consult with the USFWS to determine if the proposed project would affect protected species. This consultation may be on an informal or formal basis.

This EIS is intended to meet the requirements under National Environmental Policy act (NEPA) for Reclamation to permit and implement the proposed water exchange. In addition, the following laws, regulations, and executive orders may be applicable to the project.

Endangered Species Act of 1973, as Amended, and the California Endangered Species Act

A list of Federal and State threatened, endangered, proposed listed, candidate, rare, species of concern, and/or species of special concern that may occur in the study area was requested from the USFWS, on August 29, 2001. On October 24, 2001, the USFWS provided a list of protected species in the eleven 7.5-minute USGS quadrangles surrounding the project vicinity. Also, a list of state endangered, threatened, proposed listed, candidate, rare, and species of special concern was obtained from a query of the California Natural Diversity Database (CNDDB). In addition, a letter from W. Loudermilk, Regional Manager San Joaquin Valley and Southern Sierra Region CDFG, dated July 13, 2001, identified protected species in the project vicinity.

Reclamation informally consulted with USFWS on the effects of the 2002 pumping program. Reclamation (Young 2002) summarized the conclusions and agreements of this informal consultation on May 9, 2002.

In other actions in the region, Reclamation initiated formal consultation with the USFWS pursuant to Section 7 of the ESA on several refuge water supply conveyance projects within the San Joaquin Valley in January 1999. This consultation included projects at the Mendota Wildlife Area (MWA). The USFWS subsequently issued a Biological Opinion on these conveyance projects (dated June 28, 1999).

Executive Order 11988, Floodplain Management (EO 11988)

This Executive Order requires federal agencies to prepare floodplain assessments for proposals located within or affecting floodplains. If any agency proposes to conduct an action within a floodplain, it must consider alternatives to avoid adverse effects and incompatible development. If the only practicable alternative involves siting in a floodplain, the agency must minimize potential harm to or within the floodplain and explain why the action is there. No impacts are anticipated to floodplain areas.

Executive Order 11990, Protection of Wetlands (EO 11990)

This Executive Order requires federal agencies to prepare wetlands assessments for proposals located within or affecting wetlands. Agencies must avoid undertaking new construction located in wetlands unless no practicable alternative is available, and the Project Alternatives include all practicable measures to minimize harm to wetlands. The proposed action and alternatives do not involve construction activities within wetlands.

Executive Order 12898, Environmental Justice (EO 12898)

This Executive Order requires each federal agency to achieve environmental justice as part of its mission by identifying and addressing disproportionately high and adverse human health or environmental effects, including social and economic effects, of its programs, policies, and activities on minority populations and low-income populations of the United States. Reclamation has determined that none of the alternatives would disproportionately affect minority or low-income populations. Impacts identified in the socioeconomic and environmental justice sections of Section 4 are anticipated to be less than significant, in addition to being shared across income levels.

Fish and Wildlife Coordination Act (16 U.S.C. 661-666c)

Under the Fish and Wildlife Coordination Act any federal agency that proposes to control or modify any body of water must first consult with the USFWS or National Marine Fisheries Service (NMFS), as appropriate, and with the head of the appropriate state agency exercising administration over the wildlife resources of the affected state.

Reclamation informally consulted with USFWS on the effects of the 2002 pumping program. Reclamation (Young 2002) summarized the conclusions and agreements of this informal consultation on May 9, 2002. Reclamation is consulting with USFWS on this project. The California Department of Fish and Game has been encouraged to participate in the review of this EIS and previous documents.

Delta Protection Act (Water Code section 12,200 et seq.)

This Act enumerates guidelines necessary to ensure the sufficiency of the Delta's water supply. To the extent that diversion or use of water within the Delta would contribute to the inability to provide a supply of water necessary to maintain all current functions of the water housed therein, such diversion or use is prohibited.

The proposed action and alternatives would not result in increased diversions of water from the Delta. Under the Proposed Action, water already diverted from the Delta would be redirected from the Delta-Mendota Canal into the SLC.

National Historic Preservation Act (NHPA) of 1966

The NHPA, as amended, requires the lead construction agency to identify significant cultural resources that may be affected by a project and to consult with the Advisory Council on Historic Preservation and State Historic Preservation Officer concerning significant cultural resources.

No construction activities are included in the proposed action. Installation of new wells are part of normal agricultural practices in active farmlands.

San Joaquin River Act (Water Code section 12;200 et seq.)

This Act prohibits actions that may cause or contribute to the further degradation of the San Joaquin River. This act also deems unlawful the diversion of water to which users along certain enumerated stretches of River are entitled.

The proposed action and alternatives do not involve diversion of water from the San Joaquin River, and would not result in further degradation of the San Joaquin River.

Indian Trust Assets

It is Reclamation's policy to protect Indian Trust Assets from adverse impacts of its programs and activities whenever possible. Types of actions that could affect Indian Trust Assets include an interference with the exercise of a reserved water right, degradation of water quality where there is a water right, impacts on fish and wildlife where there is a hunting or fishing right, or noise near a land asset where it adversely affects uses of the reserved land (Reclamation 1997). There are no Indian Trust Assets in the project vicinity.

Central Valley Project Improvement Act (CVPIA) (Public Law 102-575, Title XXXIV)

The CVPIA amends the previous authorizations of the California CVP to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with irrigation and domestic water supply uses, and fish and wildlife enhancement having an equal priority with power generation.

Warren Act

The Warren Act specifies that any entity wishing to use Reclamation facilities to transfer non-project water may do so, subject to certain conditions. These conditions include the provision that there is sufficient excess capacity available in the system to effect the transfer, and that the entity provides the necessary power required to move the water. The Warren Act also regulates the quality of water that may be pumped into the Delta-Mendota Canal.

Table 1-1. Westlands Water District CVP Supply Allocation History, 1980-2001

Year	Allocation	Percentage of Full Entitlement	Water Year Classification
1980	1,150,000	100%	Above Normal
1981	1,151,935	100%	Dry
1982	1,150,000	100%	Wet
1983	1,150,000	100%	Wet
1984	1,150,000	100%	Above Normal
1985	1,150,000	100%	Dry
1986	1,433,102	125%	Wet
1987	1,150,000	100%	Dry
1988	1,150,000	100%	Critically Dry
1989	1,150,000	100%	Dry
1990	575,000	50%	Critically Dry
1991	315,298	27%	Critically Dry
1992	305,072	27%	Critically Dry
1993	617,391	54%	Above Normal
1994	488,878	43%	Critically Dry
1995	1,150,000	100%	Wet
1996	1,092,500	95%	Wet
1997	1,035,000	90%	Wet
1998	1,150,000	100%	Wet
1999	805,000	70%	Wet
2000	747,500	65%	Above Normal
2001	517,500	45%	Dry

Avg.	935,644	81%
Max	1,433,102	125%
Min	305,072	27%
St. Dev.	325,790	28%

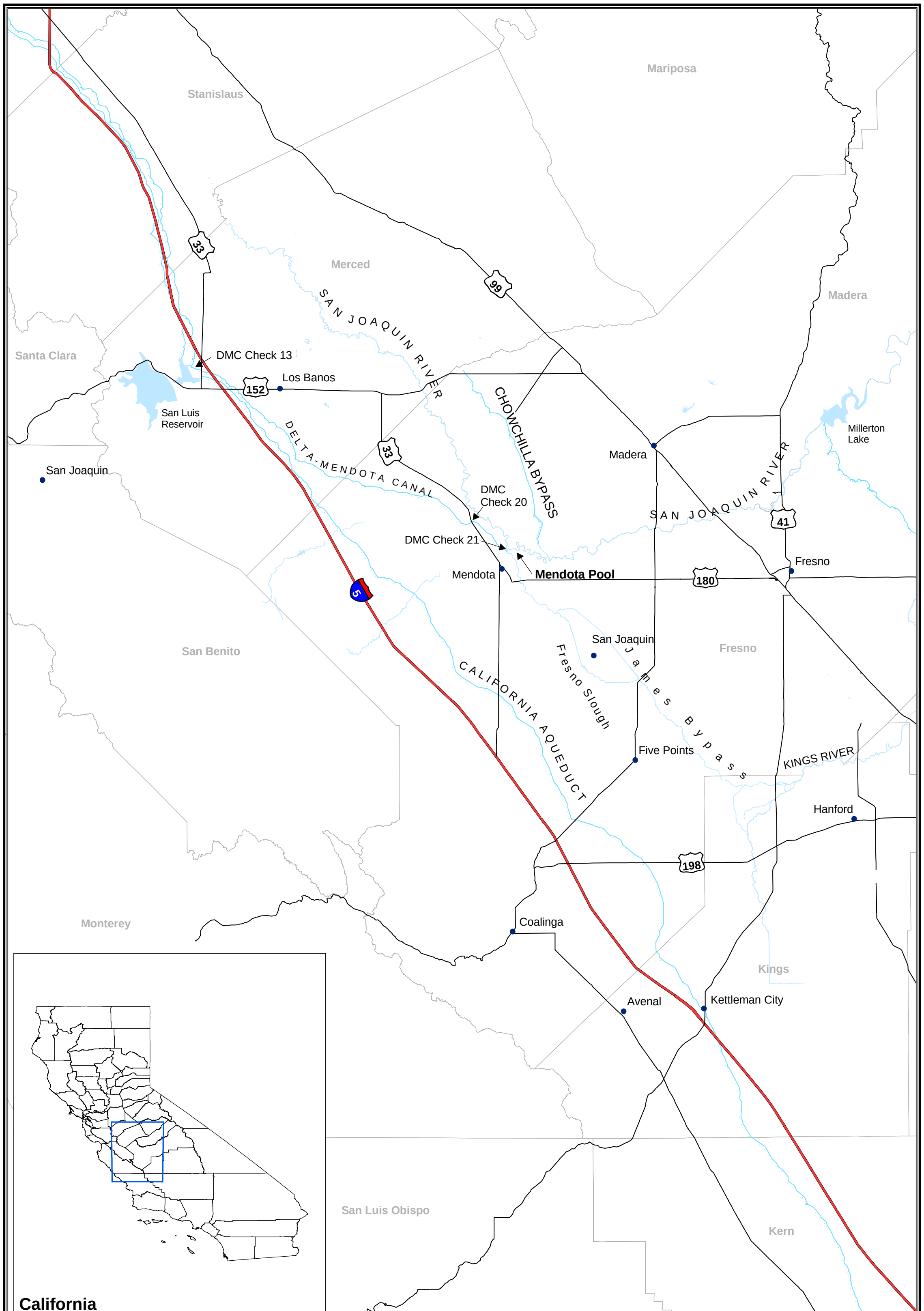
Source: Westlands Water District

Table 1-2. Annual Mendota Pool Group Pumpage and Exchange with USBR

Year	Pumpage by wells along Fresno Slough		Pumpage by wells south of San Joaquin River		Total		Total Pumpage (af)	Total Exchanged with USBR (af)
	Transfer (af)	Adjacent (af)	Transfer (af)	Adjacent (af)	Transfer (af)	Adjacent (af)		
1997	19,977	3,323	6,604	6,301	26,581	9,624	**36,205**	N/A
1998	1,000	1,268	0	5,593	1,000	6,861	**7,861**	**0**
1999	14,871	5,701	4,850	7,946	19,721	13,647	**33,368**	**5,797**
2000	14,974	9,104	4,021	7,061	18,995	16,165	**35,160**	**7,162**
2001	18,520	9,519	8,017	4,013	26,537	13,532	**40,069**	**17,280**

Table 1-3. Previously Proposed Mendota Pool Group Pumping Programs

Proposal	Annual Volume (acre-feet)	Pumping Period	Duration (years)	Total Volume (acre-feet)	Mitigation Actions
Draft EIR (Jones and Stokes 1995)	78,000	year round	20	1.56 million	1) Various
Final EIR (Jones and Stokes and LSCE 1998)	31,600 - normal year (12) 60,000 - dry year (4) 0 - wet year (4)	5 months 10 months -	20	620,000	1) Reduce pumpage to average of 31,000 af/y 2) Maintain water quality at SJREC intakes 3) No introduction of water to California Aqueduct
10-year Mitigated Pumping Program (KDSA and LSCE 2000b)	31,600 - normal year (6) 40,000 - dry year (2) 0 - wet year (2)	9.5 months 10 months -	10	269,600	1) Reduce pumpage to average of 27,000 af/y 2) Reduce and schedule deep zone pumping 3) Maintain water quality at SJREC intakes 4) No introduction of water to California Aqueduct 5) Reimbursement for increased pumping and other costs 6) Limit total subsidence to 0.05 ft at Yearout Ranch
2001 Pumping Program (implemented)	31,000	6.5 months	1	31,000	1) Reduce pumpage to 31,000 af/y 2) Reduce and schedule deep zone pumping 3) Maintain water quality at SJREC intakes 4) No introduction of water to California Aqueduct 5) Reimbursement for increased pumping and other costs 6) Limit subsidence to 0.005 ft/y at Yearout and Fordel extensometers
2002 Pumping Program (implemented)	31,600	9 months	1	31,600	1) Limit pumpage to 31,600 af/y 2) Reduce and schedule deep zone pumping 3) Maintain water quality at SJREC intakes 4) No introduction of water to California Aqueduct 5) Reimbursement for increased pumping and other costs 6) Limit subsidence to 0.005 ft/y at Yearout and Fordel extensometers 7) Maintain water quality at Mendota Wildlife Area



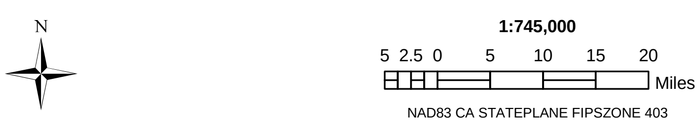


Figure 1-1
Location Map

ENTRIX

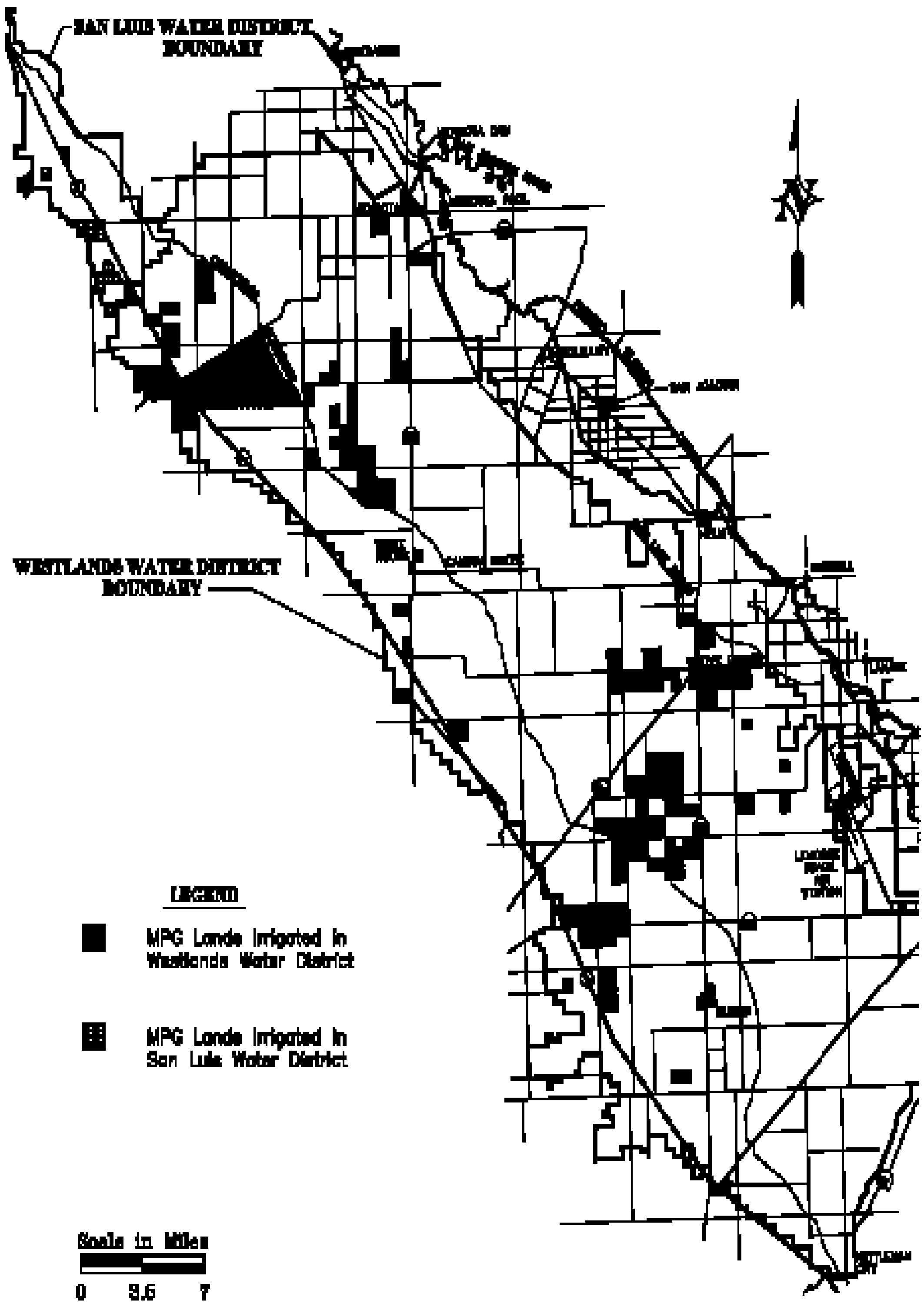


Figure 1-2. Lands Irrigated by the Mendota Pool Group in Westlands Water District and San Luis Water District

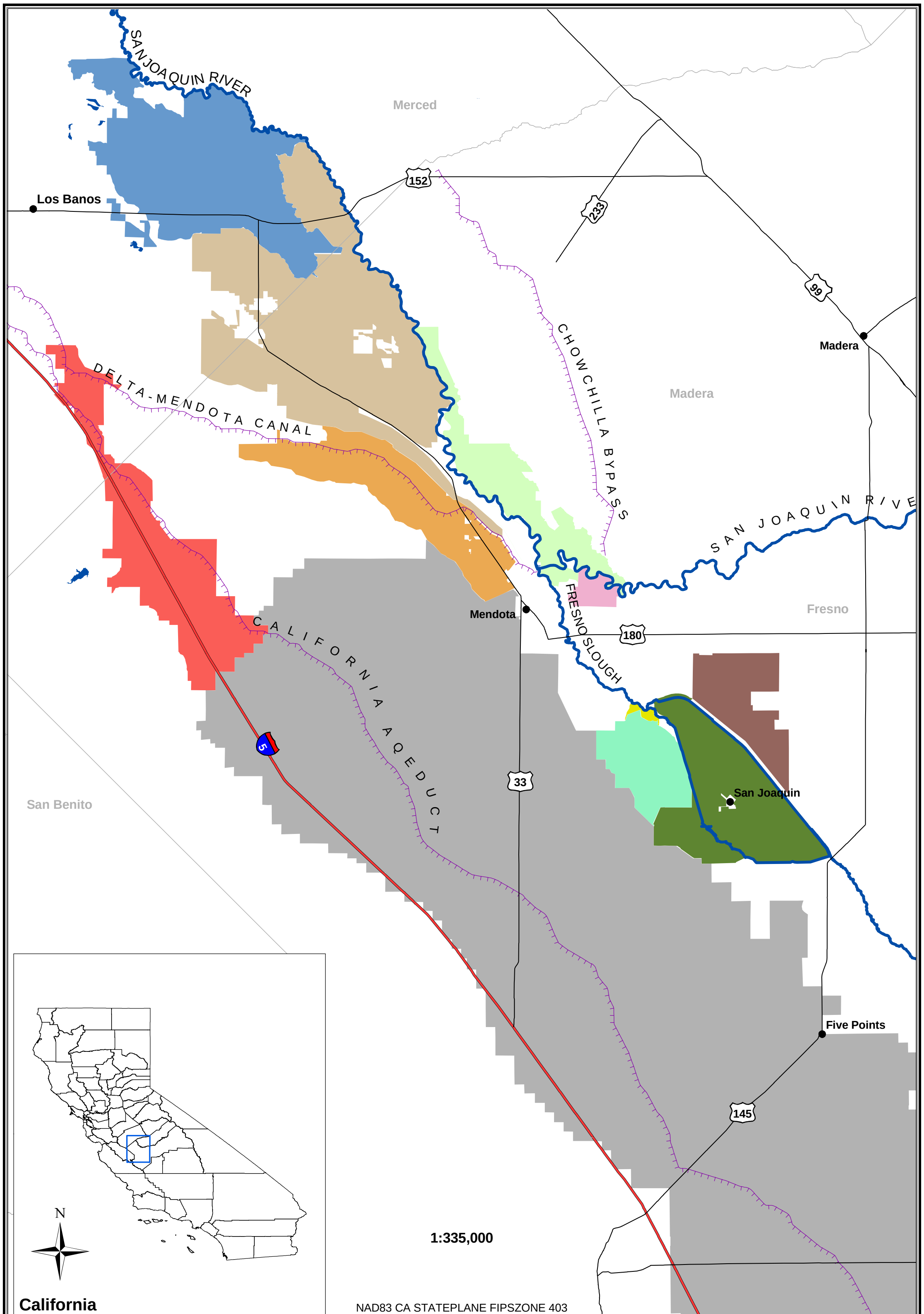


Figure 1-3
Neighboring Water Districts

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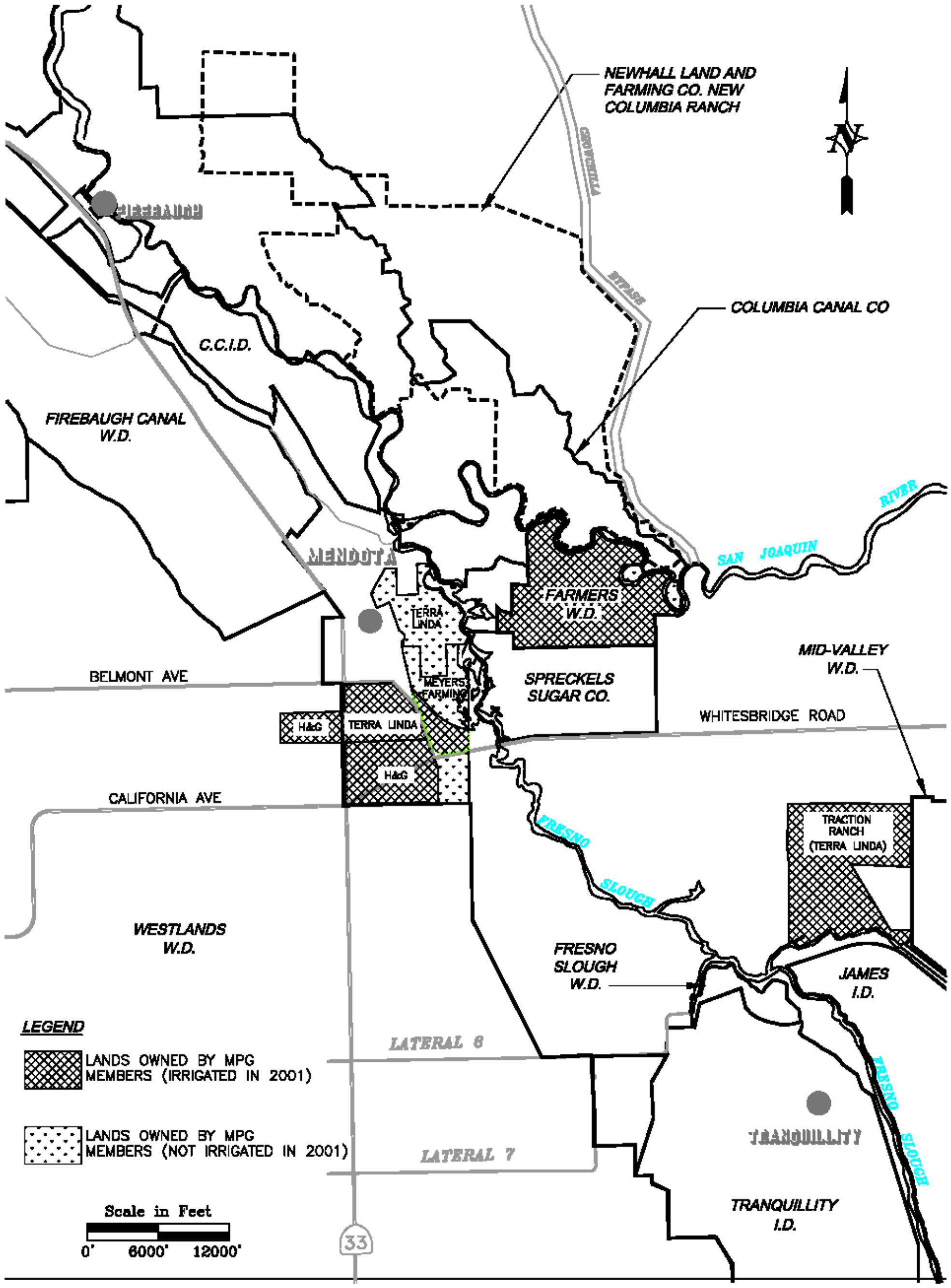

Figure 1-4. Mendota Pool Group Land Adjacent to the Pool

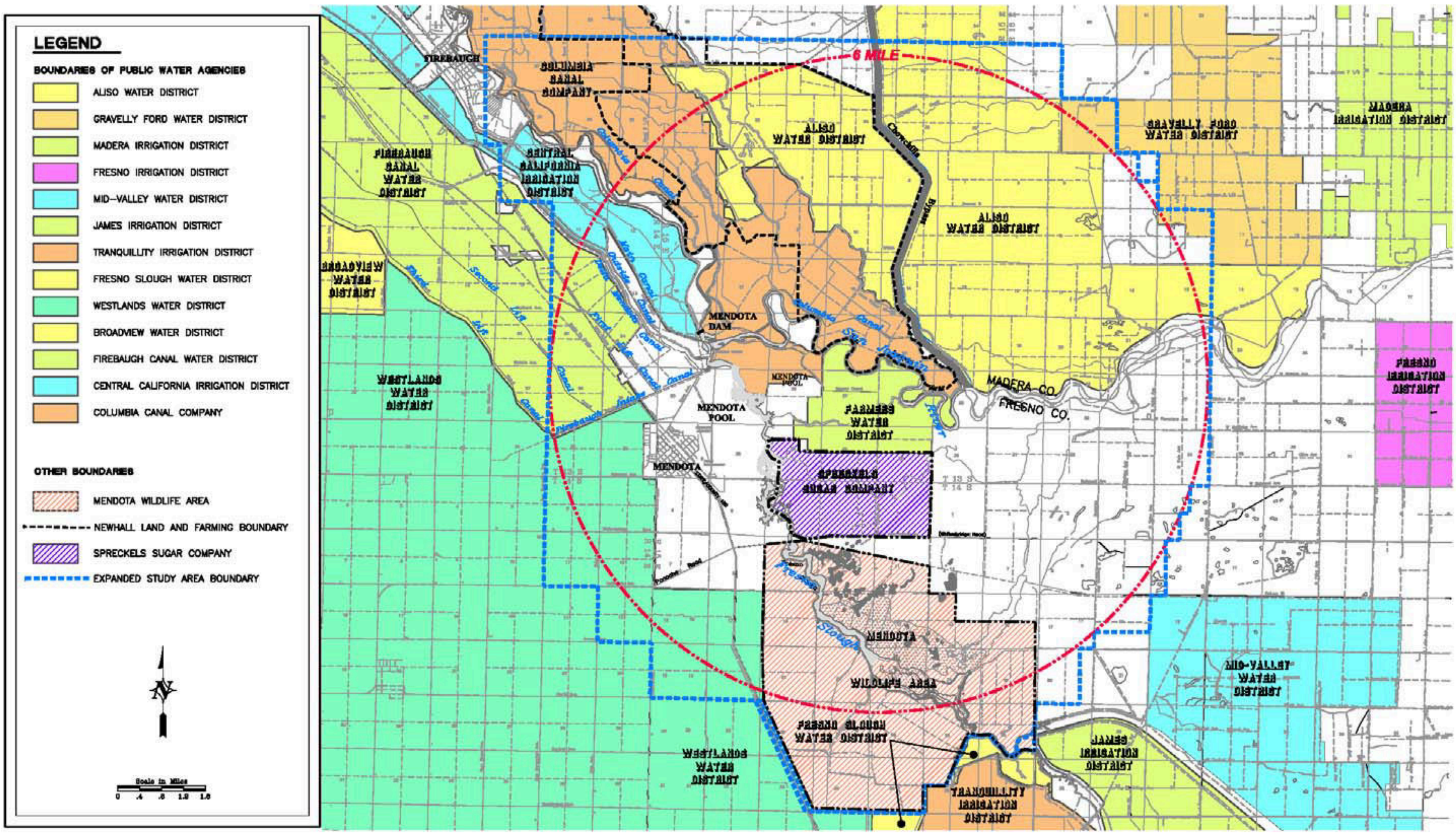

Figure 1-5. Study Area for Evaluation of Groundwater Drawdowns Due to MPG Pumping Along Mendota Pool

Discussions concerning the nature and magnitude of the MPG transfer pumping program have been ongoing since at least 1994. Five alternatives to the original project were evaluated in detail in the FEIR (Jones and Stokes and LSCE 1998). Additional negotiations have been undertaken between the interested parties since the release of the FEIR. The "Settlement Agreement for Mendota Pool Transfer Pumping Project" (Settlement Agreement) modified the project description presented in the FEIR and was based on results from field testing and monitoring efforts (KDSA and LSCE 2000a,b). The Settlement Agreement sets the guidelines for the proposed project and potential alternatives to the project.

2.1 DESCRIPTION OF PROPOSED ALTERNATIVES

This section provides a description of the Proposed Action, and two alternatives to the project. Other alternatives considered in the FEIR (Jones and Stokes and LSCE 1998) have been eliminated from further consideration in this EIS, because they were determined in the FEIR to be not feasible.

2.1.1 PROPOSED ACTION

The project proponents (i.e., the Mendota Pool Group) propose to pump up to 269,600 acre-feet of groundwater for transfer over a ten-year period from wells located adjacent to the Mendota Pool into the Mendota Pool. As used in this EIS, the term "transfer pumping" refers to all water pumped by the MPG into the Mendota Pool for delivery to WWD, exchange, or trade with others. The maximum volume of water to be pumped each year would be based on hydrologic supply conditions and would be subject to the design constraints specified in Section 2.1.1.3. Up to 25,000 acre-feet of water would be exchanged with Reclamation each year to make up for a portion of the annual shortfall in the contract water delivered via the CVP.

The water pumped into the Mendota Pool would be made available to Reclamation to offset existing water contract obligations in the Mendota Pool. In exchange, Reclamation would make an equivalent amount of CVP water (up to 25,000 acre-feet) available to the members of the MPG for irrigation purposes at Check 13 of the DMC (Tracy Pumping Plant and SLR). The federal action that requires the preparation of this EIS is the proposed exchange of up to 25,000 acre-feet of the water pumped during any given year. A maximum of 200,000 acre-feet of water would be exchanged with Reclamation over the 10-year period.

Any quantity of water pumped by the MPG beyond the 25,000 acre-feet exchanged with Reclamation each year would be available for exchange or trade with other users for use on lands that are presently under irrigation around the Mendota Pool. As part of this program, a maximum of 12,000 acre-feet of groundwater would be pumped for transfer from deep wells (i.e., perforated interval[1] greater than 130 feet deep), with the remainder coming from shallow wells (i.e., perforated interval less than 130 feet deep) on an annual basis.

The maximum allowable quantity of water to be pumped in a given year would depend on whether the year is classified as wet (0 acre-feet per year), normal (up to 31,600 acre-feet per year), or dry (up to 40,000 acre-feet per year) (Table 2-1). The MPG will determine the classification of each year during the spring, based primarily o+n estimated water demands and the projected allocations for that year. The projected allocations will be based in part on the April 15 estimate of agricultural water allocations made by Reclamation each year. This projection will be used as a guide to determine the classification of each year:

- Wet year – projected allocations greater than 60 percent of full contract allocations
- Normal year - projected allocations between 30 percent and 60 percent of the full allocation
- Dry year – projected allocations at 30 percent or less of the full allocation.

Other factors that will be considered in the classification of the water year type are the requirements of the Settlement Agreement, which states that two years out of 10 must be classified as wet, no more than two years can be classified as dry, and two consecutive years cannot be classified as dry.

2.1.1.1 Pumping Program

The groundwater pumping program will be adaptively managed to minimize any potential environmental impacts. Pumping programs will be developed and reviewed on an annual basis to allow for year-to-year variations in hydrologic conditions. The pumping program will be defined in the spring, prior to the start of pumping. The pumping program would be based on consideration of several parameters including the design constraints (Section 2.1.1.3), the results of the previous year's monitoring program, the extent of groundwater level recovery, hydrologic conditions, and any Reclamation contractor's rescheduling of CVP deliveries from the previous water year. Rescheduled deliveries may occur between March 1 and April 15 each year. During the period that rescheduled deliveries are being made, no pumping into the Mendota Pool would be allowed.

Table 2-2 provides a typical pumping program for a "normal" year in which 31,000 acre-feet would be pumped. Transfer pumping would be conducted over a maximum of a 9 month period each year, between March 1 and November 30. The annual pumping programs would consist of three seasonal components: spring, summer, and fall. During the spring (March through May), both shallow and deep wells would be pumped. During the summer (June through mid-September), only shallow wells would be pumped. However, during years when the program does not begin until after April 1, deep wells would be pumped during the month of June. During the fall (mid-September through November), both shallow and deep

[1] The perforated interval is the perforated (or screened) portion of a well through which groundwater can enter. Wells that are perforated at different depths tap groundwater from different layers.

wells would be pumped. Additional constraints on groundwater quality would be implemented during the fall season to ensure that water delivered to the MWA meets CDFG's water quality criteria. Furthermore, during a given year, adjustments may be made to the pumping program if the monitoring program indicates that actions need to be taken to maintain water quality in the Mendota Pool.

During a "dry" year, up to 40,000 acre-feet of water would be pumped for transfer. However, a maximum of 25,000 would be exchanged with Reclamation. The remainder of the water would be exchanged with other users around the Mendota Pool. The dry year pumping program would conform to all the design constraints imposed on the normal year pumping program.

During a "wet" year, no transfer pumping would be conducted. No water would be exchanged with Reclamation.

Wells included in the MPG pumping and monitoring wells are mapped in Figure 2-1. Water quality of production wells used in 2002 is provided in Table 2-3. No additional wells or other facilities would be constructed as part of this project. However, normal irrigation practices may require refurbishing or replacement of existing wells. Some wells may be taken out of service during this program due to water quality impacts. These wells may be replaced by others with better water quality.

2.1.1.2 Water Distribution

Once the water has been pumped into the Mendota Pool, it would be provided to farmlands owned or operated by MPG members in the following three ways (M. Carpenter 2001, pers. comm.):

- Delivery from the Mendota Pool to irrigated farmlands in WWD via Lateral 6, and possibly Lateral 7. Since most of the MPG lands are not served by these laterals, some of this water would be exchanged with WWD for other water delivered to MPG lands via the SLC;
- Exchange with other water districts for water delivered to MPG lands via the SLC; and
- Exchange of up to 25,000 acre-feet with Reclamation for water at Check 13 of the DMC (i.e., the O'Neill Forebay) and conveyed via the SLC for delivery to MPG farmlands in WWD and SLWD. This is the proposed action of this EIS.

The exchanged water would be used on farmlands owned or operated by MPG members within WWD and/or the SLWD (Figure 1-2). Although a small portion of the MPG lands are in drainage-impaired areas, the amount of water to be delivered to these lands is not likely to worsen existing drainage problems. Farmers in these areas use drainage control practices to maintain historical production. Use of local groundwater would impact crop production and groundwater quality due to accumulation of salts in the soil profile. The MPG will not translocate water from the Mendota Pool to the California Aqueduct for transfer to the southern Central Valley or southern California.

2.1.1.3 Program Design Constraints

The proposed project incorporates several design constraints intended to prevent adverse environmental effects. Some of these constraints were initially specified in the Settlement Agreement between the MPG, the SJREC, and NLF. Additional constraints were developed based on the results of previous monitoring efforts and to address concerns of other water users around the Mendota Pool. These constraints were intended to minimize the potential environmental impacts of the proposed pumping program. The constraints apply to the initial design of the annual pumping programs, and to triggers based on the results of the annual monitoring program. These design constraints include:

- Pump MPG wells along the Fresno Slough only when flow in the Fresno Slough is to the south. Wells in FWD could pump irrespective of flow direction.

- Shut off MPG wells if electrical conductivity (EC) measurements at the Exchange Contractors' canal intakes exceed that of the DMC by 90 μmhos/cm for a period of three days or more. If the MPG wells are shut off for this reason, they would not be turned back on until the EC at the canal intakes returns to a level that is no more than 30 μmhos/cm above the DMC inflow.

- Minimize deep zone drawdowns by reducing MPG deep zone transfer pumping during the summer months when the majority of non-MPG irrigation pumping occurs in the Mendota area.

- Limit deep zone drawdowns throughout the pumping program to limit subsidence at the Yearout Ranch and Fordel extensometers caused by transfer pumping to less than an average of 0.005 foot per year over the ten-year period. Compaction data collected from the extensometers will be used along with model results to estimate the amount of subsidence cause by MPG pumping each year.

- Modify the pumping program based on the results of the surface water monitoring program to reduce overall surface water quality degradation, particularly with respect to salinity [total dissolved solids (TDS) or EC]. This will ensure that the quality of water supplied to the MWA and other users in the southern portion of the Mendota Pool will meet applicable water quality criteria. Wells with TDS concentrations greater than 2,000 mg/L will not be pumped as part of the proposed action. During the fall pumping period, when there is reduced flow in the Mendota Pool and water quality at the MWA is most critical, wells with TDS higher than 1,200 mg/L will not be pumped for transfer.

- Shut off wells with selenium concentrations equal to or greater than the water quality criterion of 2 μg/L.

- Minimize groundwater quality degradation by modifying the pumping program based on the results of predictive modeling of the effects of the pumping program and the results of the groundwater monitoring program, and by minimizing drawdowns.

Total transfer pumping from the deep zone would be limited to 12,000 acre-feet per year. The purpose of this limit on deep zone pumpage is to reduce the average subsidence caused by transfer pumping to less than 0.005 foot per year and to reduce water level impacts and the rate of groundwater quality degradation that would otherwise occur.

If 12,000 acre-feet of water are pumped from the deep zone, shallow zone pumping would be limited to 19,600 acre-feet during a normal year and 28,000 acre-feet per year in a dry year. Shallow zone pumpage may also be limited due to (1) the quality of water pumped from these wells, and (2) potential impacts on deep zone groundwater (e.g., overdraft).

There are five MPG wells located in Madera County, adjacent to the East and West Loops of the San Joaquin River. These five wells (Farmers Water District WL-1, WL-2, WL-3, EL-2, and EL-3) will not be pumped for transfer, and will not constitute part of the exchanged waters.

Additional mitigation actions are included in the proposed project. Beginning with the 2001 irrigation season, the MPG has offered to compensate the other major groundwater pumpers in the Mendota area for increased power and other additional costs due to drawdowns estimated to have been caused by the MPG transfer pumping.

2.1.1.4 Monitoring Program

The MPG, in cooperation with other interested parties, has designed a surface water, groundwater, and subsidence monitoring program to assess the impacts of this project. The current monitoring program was developed with input from the USFWS, the U.S. Geological Survey (USGS) and the CDFG. The monitoring program was initiated in 1999 and is planned to last for the duration of the project. In 2001, the MPG implemented a sediment sampling program to assess accumulation of selenium, boron, arsenic, and molybdenum in Mendota Pool sediments. The complete monitoring program is described in Appendix B. The monitoring program consists of the following components:

- Monitor pumpage of the MPG wells on at least a monthly basis
- Measure groundwater levels on a bimonthly basis throughout the year
- Sample groundwater quality on an annual basis
- Evaluate data from continuous EC recorders located at the DMC, the Exchange Contractors' intakes, and the MWA at regular intervals
- Conduct surface water quality sampling during the pumping season
- Conduct sediment sampling at eight locations in the fall of each year

A quality assurance/quality control program is in place to verify accuracy of monitoring data. The monitoring data are provided to Reclamation to verify full implementation of the pumping and monitoring plan. In addition, monitoring data are provided to USFWS, CDFG, SJREC, and NLF, among others.

The monitoring program involves the participation of the MPG and several entities around the Mendota Pool (Table 2-4). The entities that have contributed to the monitoring program in the past include the SJREC, NLF, San Luis and Delta-Mendota Water Authority (SLDMWA), City of Mendota, and Spreckels Sugar Co. The participation of the MPG, SJREC, and NLF in the monitoring program is required under the terms of the Settlement Agreement. Data that are obtained by the SLDMWA as part of its responsibilities to manage the flow of water in the Mendota Pool are provided to the MPG. The City of Mendota and Spreckels Sugar Co. are not obligated to participate in the monitoring program, and have intermittently provided data when requested. Other entities that provided data for the monitoring program in 2002 include Reclamation, DWR, Mendota Biomass, James Irrigation District (JID), Aliso Water District, and Gravelly Ford Water District. Data collected by these entities are provided to the MPG for compilation and analysis.

The data are summarized in an annual monitoring report at the conclusion of the pumping season. The results of the monitoring program will be used in the design of the subsequent year's pumping program.

2.1.2 NO ACTION ALTERNATIVES

Two No Action alternatives are described in this section. These alternatives assume that Reclamation does not allow the proposed exchange of groundwater pumped into the Mendota Pool for water taken from the DMC at Check 13. Therefore, the MPG would not be able to obtain supplemental (i.e., exchanged) water via the SLC for delivery to lands in portions of WWD and SLWD.

The No Action alternatives assume the continuation of WWD's efforts to secure water transfers and implement its water conservation program. The current level of groundwater pumping for local use by farmers and others in the Mendota region would remain without the project.

Should Reclamation decide not to implement the Proposed Action, then the MPG members would independently seek to obtain water from other sources in order to maintain agricultural production to the fullest extent possible. This EIS considers two options that are the most feasible and could be implemented by the MPG. These options are:

- New Well Construction – in SLWD and WWD to provide 25,000 acre-feet of groundwater per year.

- Land Fallowing – temporary removal of land from production and reallocation of water to other land under production.

These options are discussed in more detail below. In addition to these alternatives, the MPG could continue to pump up to 9,000 acre-feet per year into the Mendota Pool for exchange or trade with other users around the Mendota Pool or conveyed to WWD via Laterals 6 or 7 (Table 2-1). The amount of water traded would depend on the amount of water available from existing Reclamation CVP contractors receiving CVP project water at the Mendota

Pool, cropping patterns, availability of conveyance capacity, and amount of land fallowed. This action would not require any State or Federal permits.

In the analysis presented in this EIS, the Well Construction and Land Fallowing options will be treated as independent actions. In reality, individual members of the MPG may choose either of these options, or choose some combination of the two. A comparison of the total pumpage for each alternative over the 10-year program is provided in Table 2-5.

2.1.2.1 New Well Construction

To compensate for the 25,000 acre-feet of water that would have been provided through the exchange with Reclamation, the MPG members may choose to install new wells in WWD and SLWD to provide irrigation water for overlying lands. These wells would likely tap water from below the Corcoran Clay where water quality is generally better than in the aquifer above the Clay.

The irrigation season in WWD and SLWD typically extends from June through August (92 days) (Jones and Stokes, 1995). As the typical well capacity in WWD is approximately 2.5 cfs (M. Carpenter, 2002, pers. comm.), it would require approximately 55 wells operating at full capacity throughout the irrigation season to provide the required 25,000 acre-feet of water. Due to the need to provide water during certain peak portions of the year, or due to the higher demands of certain crops (e.g., cotton), as many as 125 wells could be required. The wells would be installed adjacent to the fields to be irrigated, or linked to the WWD or SLWD distribution systems. This alternative also assumes that during the years when anticipated allocations are greater than 60 percent of full allocation (i.e., “wet” years), these wells would not be pumped, as sufficient surface water supplies would be available from Reclamation.

This alternative would require additional piping to distribute water to the fields, or to connect to existing WWD or SLWD distribution systems. The wells would be high-efficiency wells constructed of stainless steel with a limited perforation interval. A typical well would be approximately 1000 feet deep and powered by a 250 horsepower electric motor.

This alternative would not be subject to the design constraints or monitoring program requirements of the proposed action.

2.1.2.2 Land Fallowing

This alternative would compensate for the 25,000 acre-feet of water that would not be provided through the exchange with Reclamation by fallowing an amount of land equivalent to that which could have been irrigated by 25,000 acre-feet of water. The lands irrigated by the MPG in WWD and SLWD typically require 3 acre-feet of water per acre of land per year to maintain production (M. Carpenter, 2001 pers. comm.). Fallowed land requires approximately 0.5 acre-foot of water per year for weed suppression activities. Therefore, the farmers could reallocate approximately 2.5 acre-feet of water per acre of land fallowed. In order to compensate for the 25,000 acre-feet of water that would not be exchanged, a total of 10,000 acres would need to be fallowed on an annual basis. This alternative also assumes that during the years when anticipated allocations are greater than 60 percent of full allocation (i.e., “wet” years) no land would be fallowed, as sufficient surface water supplies would be available from Reclamation.

This alternative would not require construction of any additional wells or distribution facilities. This alternative would not be subject to the design constraints or monitoring program requirements of the proposed action.

2.1.3 Alternatives Removed from Further Consideration

An alternative that would shift some pumpage from dry years to wet years was initially considered. This alternative would be substantially similar to the Proposed Action with the exception of changes to the amounts of dry and wet year pumping. Both the total amount of water to be pumped over the 10-year period (269,000 acre-feet) and the amount of water to be exchanged with Reclamation over 10-year period (200,000 acre-feet) would be the same as in the proposed action.

In this alternative, dry years would be treated identically to normal water supply years. During dry years, up to 31,600 acre-feet of water would be pumped for exchange, with up to 25,000 acre-feet exchanged with Reclamation. During each of the two wet years, up to 8,400 acre-feet would be pumped for exchange with others around the Mendota Pool. No water would be exchanged with Reclamation during the wet years.

This alternative was rejected because it would require modification of the terms of the Settlement Agreement.

2.2 Description of Past, Present, and Reasonably Foreseeable Future Actions Not Part of the Proposed Project but Related to Cumulative Effects

Historically, other similar groundwater conveyance programs were operated on an interim basis during the 1989-1994 drought period, when the CVP and State Water Project (SWP) water supplies to federal and state contractors were reduced. The CVP and SWP have accepted well water into the aqueduct and granted credit to their water users for future use as a means of managing and distributing scarce water supplies.

Because surface water supplies are currently limited and are expected to remain limited, most farmers in the region are expected to continue to pump groundwater to irrigate their fields. Should future events further limit the ability of the CVP and SWP to meet their water contracts, additional demands may be placed on groundwater supplies.

Limitations on MPG pumping for adjacent use are included in the Settlement Agreement, and are based on the volume of transfer pumping. The MPG may pump up to 14,000 acre-feet per year (in addition to the groundwater pumped for transfer) to irrigate overlying/adjacent lands (referred to as adjacent use pumpage) (Table 2-6). This water would be used on overlying lands or lands adjacent to the Mendota Pool (Figure 1-4) and is independent of which alternative is selected.

The City of Mendota relies entirely on groundwater for its municipal supply and has to shifted approximately 2,400 acre-feet of its pumpage to new wells drilled on the B&B Ranch (located east of the Fresno Slough and north of the Spreckels Sugar Co.) in 2001. This project has the potential affect water quality in the Pool. The B&B Ranch is within the service area of the Columbia Canal Co. (one of the Exchange Contractors). The City's project would shift pumpage for municipal use from City of Mendota-owned wells located west of the Mendota Pool to better quality wells east of the Mendota Pool. The City of Mendota intends to exchange this water for a corresponding amount of water pumped into the Mendota Pool from wells along the Fresno Slough such as the MPG wells at Fordel, Inc. The exchanged water would be delivered to the SJREC via a canal from the Mendota Pool and used for irrigation in lieu of water that would otherwise have been pumped by the Ranch. Therefore, the total volume of groundwater pumpage on the B&B Ranch would not change. The volume of groundwater pumpage on the west side of the Fresno Slough would also remain constant, but some of the pumpage would shift from the City of Mendota's existing wells to the Fordel wells, or other wells west of the Fresno Slough. The project is not anticipated to increase groundwater pumpage by the City of Mendota. As negotiations between the City of Mendota and Fordel, Inc. have not been initiated, it is unlikely that this project and exchange will be implemented prior to 2003.

Industrial users such as Spreckels Sugar Co. and Mendota Biomass also depend on groundwater to operate their facilities. Other influences on groundwater quality include seepage from Spreckels Sugar Co. wastewater ponds and City of Mendota sewage treatment facilities.

Numerous users have historically required water deliveries through the Mendota Pool during the fall months (October to December), including JID, Tranquillity Irrigation District, Fresno Slough Water District, and the MWA. The largest of these users is the MWA, which uses the water to provide wildlife habitat. Water deliveries to users taking water from the southern portion of the Mendota Pool were 13,600 acre-feet in 1999 (2 months), 14,200 acre-feet in 2000 (3 months), and 10.700 acre-feet in 2001 (2 months) (San Luis and Delta-Mendota Water Authority 2001). It is anticipated that there would be a similar demand in future years.

Table 2-1. Proposed Alternatives for Evaluation in the EIS - Pumpage and Land Fallowed

					Cumulative Impacts				
	Total Pumpage (up to)	Exchange w/ Reclamation (up to)	Exchange with Others (acre-feet)	Land Fallowed (acres)	Adjacent Use (acre-feet)	City of Mendota (acre-feet)	Meyers Water Bank	Spreckels Sugar	Current Uses
Proposed Action									
Wet Year (2)[a]	0	0	0	0	14,000	2,400	Y	Y	Y
Normal Year (6)	31,600	25,000	6,600	0	14,000	2,400	Y	Y	Y
Dry Year (2)	40,000	25,000	15,000	0	14,000	2,400	Y	Y	Y
Well Construction in WWD and SLWD									
Pumpage To Pool (10)	9,000	0	9,000	0	14,000	2,400	Y	Y	Y
In WWD and SLWD									
Wet Year (2)	0	0	0						
Normal Year (6)	25,000	0	0						
Dry Year (2)	25,000	0	0						
Land Fallowing									
Pumpage To Pool (10)	9,000	0	9,000		14,000	2,400	Y	Y	Y
Land									
Wet Year (2)				0					
Normal Year (6)				10,000					
Dry Year (2)				10,000					

[a]Numbers in parentheses indicate the number of years out of the 10 year project

Table 2-2. Typical Transfer Pumpage Program for a Normal Year

Location	Depth Zone	Mar (cfs)	Apr (cfs)	May (cfs)	Spring Total (af)	Jun (cfs)	Jul (cfs)	Aug (cfs)	Sep 1-15 (cfs)	Summer Total (af)	Sep 16-30 (cfs)	Oct (cfs)	Nov (cfs)	Fall Total (af)	Annual Total (af)
Fresno Slough (north)	Shallow	0.0	19.4	19.4	**2,343**	19.4	16.2	14.7	19.4	**3,631**	19.4	19.4	14.7	**2,642**	**8,616**
Fresno Slough (south)	Shallow	0.0	18.2	25.9	**2,675**	23.4	29.9	26.7	18.3	**5,234**	19.5	20.6	10.6	**2,475**	**10,385**
Fresno Slough (north)	Deep	0.0	7.5	6.8	**860**	0.0	0.0	0.0	0.0	**0**	0.0	0.0	0.0	**0**	**860**
Fresno Slough (south)	Deep	0.0	0.0	3.3	**250**	0.0	0.0	0.0	0.0	**0**	0.0	0.0	0.0	**0**	**205**
Farmers Water District (incl. Baker and PCF Wells)	Deep	0.0	32.2	39.5	**4,463**	23.6	0.0	0.0	0.0	**1,405**	42.0	39.8	23.0	**5,066**	**10,934**
Total Deep Pumpage		0.0	41.6	49.6	**5,528**	23.6	0.0	0.0	0.0	**1,405**	42.0	39.8	23.0	**5,066**	**12,000**
Total Transfer Pumpage		0.0	79.2	94.9	**10,547**	66.4	43.1	41.4	37.7	**10,270**	80.8	79.7	48.3	**10,183**	**31,000**

Table 2-3. Mendota Pool Group Wells - Capacities, Water Quality, Use in 2002

Well Owner and ID	Depth Zone	Capacity (cfs)	Water Quality EC (µmhos/cm)	TDS (mg/l)	As (µg/l)	B (mg/l)	Mo (µg/l)	Se (µg/l)	Water Use in 2002
Fordel, Inc.									
M-1	D	2.5	1,200	730	<2	0.56	9	<0.4	Idle
M-2	S	1.1	1,150	730	2	0.36	10	<0.4	Transfer
M-3	S	2.0	1,160	730	3	0.51	10	<0.4	Transfer
M-4	S	1.8	1,250	760	3	0.52	5.65	<0.4	Transfer
M-5	S	1.9	769	480	<2	0.35	4.55	<0.4	Transfer
M-6	S	1.4	629	390	<2	0.27	3	<0.4	Transfer
Fordel/Biomass	D	6.6	1,350	-	-	-	-	-	Idle
Terra Linda Farms									
TL-1	D	1.8	877	-	-	-	-	-	Adjacent
TL-2	D	1.8	1,440	-	-	-	-	-	Idle
TL-3	D	2.8	733	450	<2	0.35	5.53	<0.4	Adjacent
TL-4A	S	1.6	935	570	<2	0.21	8.7	<0.4	Tran/Adj
TL-4C	S	1.6	1,090	670	<2	0.27	10	<0.4	Tran/Adj
TL-5	D	6.2	1,530	900	<2	0.55	9	<0.4	Adjacent
TL-6	D	3.7	4,040	-	-	-	-	-	Idle
TL-7	D	3.6	1,140	680	<2	0.52	9.35	<0.4	Adjacent
TL-8	D	3.6	1,110	690	<2	0.56	10.7	<0.4	Tran/Adj
TL-10A	S	1.2	896	560	<2	0.26	10.6	<0.4	Transfer
TL-10B	S	1.0	989	580	3	0.25	10.2	<0.4	Transfer
TL-10C	S	0.7	882	540	6	0.29	13.0	<0.4	Transfer
TL-11	S	0.4	774	450	<2	0.28	13.7	<0.4	Transfer
TL-12	S	1.6	769	460	<2	0.28	7.25	<0.4	Transfer
TL-13	S	2.2	752	450	<2	0.26	4	<0.4	Tran/Adj
TL-14	S	1.8	1,030	620	<2	0.25	10	<0.4	Tran/Adj
TL-15	S	1.3	955	560	<2	0.28	10	<0.4	Tran/Adj
TL-16	S	1.3	921	550	<2	0.22	6.85	<0.4	Tran/Adj
TL-17	S	2.0	689	390	3	0.23	4	<0.4	Tran/Adj
Coelho/Coelho									
Conejo West	D	6.8	1,470	870	<2	0.7	-	5*	Transfer
Coelho/Coehlho/Fordel									
CCF-1	D	7.5	1,740	1,040	<2	0.62	8	<0.4	Idle
CCF-2	D	-	-	-	-	-	-	-	Idle
Silver Creek Packing									
SC-2	D	-	-	-	-	-	-	-	Idle
SC-3	D	-	-	-	-	-	-	-	Idle
SC-4	D	2.0	-	-	-	-	-	-	Idle
SC-5	D	4.0	3,970	2,140	<2	1.11	7	<0.4	Idle
SC-6	D	3.3	2,770	1,560	<2	0.72	5	<0.4	Transfer
SC-7	D	1.7	-	-	-	-	-	-	Idle
Coelho/Gardner/Hanson									
CGH-1	S	2.5	944	580	<2	0.3	4.93	<0.4	Tran/Adj
CGH-2	S	2.2	1,900	1,160	<2	0.37	6.13	<0.4	Tran/Adj
CGH-3	S	1.1	2,940	1,820	<2	0.48	8.07	<0.4	Idle
CGH-4	S	0.6	4,250	2,620	<2	0.98	16.0	<0.4	Idle
CGH-5	S	1.0	3,290	-	<2	0.7	-	<1	Idle
CGH-6A	S	1.7	2,910	1,740	<2	0.78	20	<0.4	Transfer
CGH-7	S	1.6	2,000	-	-	-	-	-	Tran/Adj
CGH-8	S	1.7	1,710	-	-	-	-	-	Tran/Adj
CGH-9	S	1.2	1,720	1,070	<2	0.39	11.1	<0.4	Tran/Adj
CGH-10	S	1.8	1,320	830	<2	0.35	13.0	<0.4	Tran/Adj

Table 2-3. Mendota Pool Group Wells - Capacities, Water Quality, Use in 2002

Well Owner and ID	Depth Zone	Capacity (cfs)	Water Quality EC (µmhos/cm)	TDS (mg/l)	As (µg/l)	B (mg/l)	Mo (µg/l)	Se (µg/l)	Water Use in 2002
CGH-11	S	1.3	2,750	1,720	<2	0.57	13.9	<0.4	Tran/Adj
Meyers Farming									
MS-1A	S	1.8	6,570	4,410	<2	1.12	15.4	<0.4	Idle
MS-2	S	1.3	5,000	3,050	<2	0.69	21.3	<0.4	Idle
MS-3	S	2.9	3,860	2,290	<2	0.65	25.9	<0.4	Idle
MS-4	S	2.6	2,730	1,740	<2	1.00	40.7	<0.4	Tran/Adj
MS-5	D	4.0	3,130	1,820	<2	0.83	18	<0.4	Idle
Five Star/Conejo Farms									
FS-1	S	0.8	1,030	590	<2	0.36	18	<0.4	Transfer
FS-2	S	0.8	1,190	740	<2	0.36	13.90	<0.4	Transfer
FS-3	S	0.8	1,930	1,200	<2	0.5	24	<0.4	Transfer
FS-4	S	0.8	1,740	1,060	<2	0.5	24.0	<0.4	Transfer
FS-5	S	0.8	1,040	640	<2	0.37	11.2	<0.4	Transfer
FS-6	S	0.8	2,340	1,390	<2	0.52	23.2	<0.4	Transfer
FS-7	S	0.8	2,500	1,600	<2	0.53	17.7	<0.4	Transfer
FS-8	S	0.8	2,240	1,310	<2	0.6	19.0	<0.4	Transfer
FS-9	S	0.8	2,090	1,290	<2	0.56	17.6	<0.4	Transfer
FS-10	S	0.8	1,400	910	<2	0.42	10	<0.4	Transfer
Coelho West									
CW-1	S	0.9	1,280	780	<2	0.44	13.5	<0.4	Transfer
CW-2	S	0.9	1,780	1,100	<2	0.61	30.5	<0.4	Transfer
CW-3	S	0.9	1,710	1,050	<2	0.51	30	<0.4	Transfer
CW-4	S	0.9	2,780	1,730	<2	0.85	59.5	<0.4	Idle
CW-5	S	0.9	2,630	1,620	<2	0.7	60	<0.4	Transfer
Farmers Water District									
R-1	D	2.5	444	290	<2	0.09	5	<0.4	Tran/Adj
R-2	D	4.0	458	270	<2	0.05	2.00	<0.4	Transfer
R-3	D	2.5	776	460	<2	0.09	1.40	<0.4	Tran/Adj
R-4	D	3.3	252	180	3	0.08	3.10	<0.4	Tran/Adj
R-6	D	3.1	558	350	<2	0.16	6.10	<0.4	Transfer
R-7	D	6.0	476	300	<2	<0.05	1.80	<0.4	Tran/Adj
R-8	D	4.7	587	340	<2	0.22	8.35	<0.4	Transfer
R-9	D	3.8	252**	-	-	-	-	-	Tran/Adj
R-10	D	3.3	810	510	<2	0.51	15.5	<0.4	Tran/Adj
R-11	D	3.1	739	470	<2	0.37	12	<0.4	Adjacent
Baker Farming Co.									
BF-1	D	4.0	497	300	<2	0.12	3.85	<0.4	Transfer
BF-2	D	1.7	497	300	<2	0.06	2	<0.4	Transfer
BF-3	D	3.6	511	310	<2	0.09	3.50	<0.4	Transfer
BF-4	D	3.3	539	310	<2	0.09	3.00	<0.4	Transfer
BF-5	D	4.2	462	300	<2	0.11	3.75	<0.4	Transfer
Panoche Creek Farms									
PCF-1	D	3.8	535	340	<2	0.15	3	<0.4	Transfer

D = deep, S = shallow
* Questionable Value.
** Value estimated based on nearby well R-4.

Table 2-4. Participants in Mendota Pool Monitoring Program.

Responsible Entity:	Monitoring Component:
Mendota Pool Group	Bimonthly groundwater level measurements; continuous water level monitoring at two locations; groundwater quality of MPG wells, monitoring wells, and other wells not monitored by others; surface water grab samples; continuous EC recorder at MWA; sediment sampling; continuous compaction monitoring at Fordel extensometer; annual water budget
San Luis & Delta–Mendota Water Authority	Pumpage of MPG wells and other inflows to and outflows from the Pool, daily water budget and flow direction
San Joaquin River Exchange Contractors Water Authority	Pumpage and water quality in SJREC wells; continuous EC recorders at canal intakes; continuous compaction and water level monitoring at Yearout extensometer
Newhall Land and Farming Co.	Pumpage, water quality, and groundwater levels in NLF wells
City of Mendota	Pumpage and water quality in its wells
Spreckels Sugar Co.	Pumpage, water quality, and groundwater levels in its wells

Table 2-5. Comparison of Proposed Alternatives.

(Cumulative volumes of water pumped and land fallowed for each alternative.)

	Alternative		
Parameter	Proposed Action	Well Construction	Land Fallowing
Duration (years)	10	10	10
Total Volume of Water Pumped into Pool (acre-feet)	269,600	90,000	90,000
Total Volume Exchanged with Reclamation (acre-feet)	200,000	0	0
Total Volume Traded with Others (acre-feet)	69,600	90,000	90,000
Total Volume Pumped in WWD and SLWD (acre-feet)	0	200000[a]	0
# Existing Deep Production Wells at Pool	35	35	35
# Existing Shallow Production Wells at Pool	46	46	46
# New Deep Production Wells in WWD and SLWD	0	55	0
# New Shallow Production Wells in WWD and SLWD	0	0	0
Acres Fallowed per Year	0	0	10,000[b]

[a]25,000 acre-feet per year in 8 of 10 years

[b]10,000 acres in 8 of 10 years

Table 2-6. Typical Adjacent Use Pumpage in a Normal Year

Location	Depth Zone	Feb (cfs)	Mar (cfs)	Apr (cfs)	May (cfs)	Spring Total (af)	Jun (cfs)	Jul (cfs)	Aug (cfs)	Sep 1-15 (cfs)	Summer Total (af)	Sep 16-30 (cfs)	Oct (cfs)	Nov (cfs)	Fall Total (af)	Annual Total (af)
Fresno Slough	Shallow	5.3	8.5	1.8	3.0	**1,104**	12.1	10.8	13.0	5.4	**2,345**	1.2	1.2	1.2	**185**	**3,633**
Fresno Slough	Deep	0.0	2.8	11.0	2.8	**1,001**	18.0	18.0	18.0	12.7	**3,478**	6.4	8.1	0.5	**723**	**5,202**
Farmers Water District (incl. Baker and PCF Wells)	Deep	0.0	4.9	9.6	8.5	**1,396**	12.3	13.6	13.6	12.7	**2,782**	12.0	6.0	4.4	**987**	**5,165**
Total Adjacent Pumpage		5.3	16.2	22.3	14.4	**3,501**	42.5	42.4	44.6	24.5	**8,605**	19.6	15.4	6.1	**1,895**	**14,000**

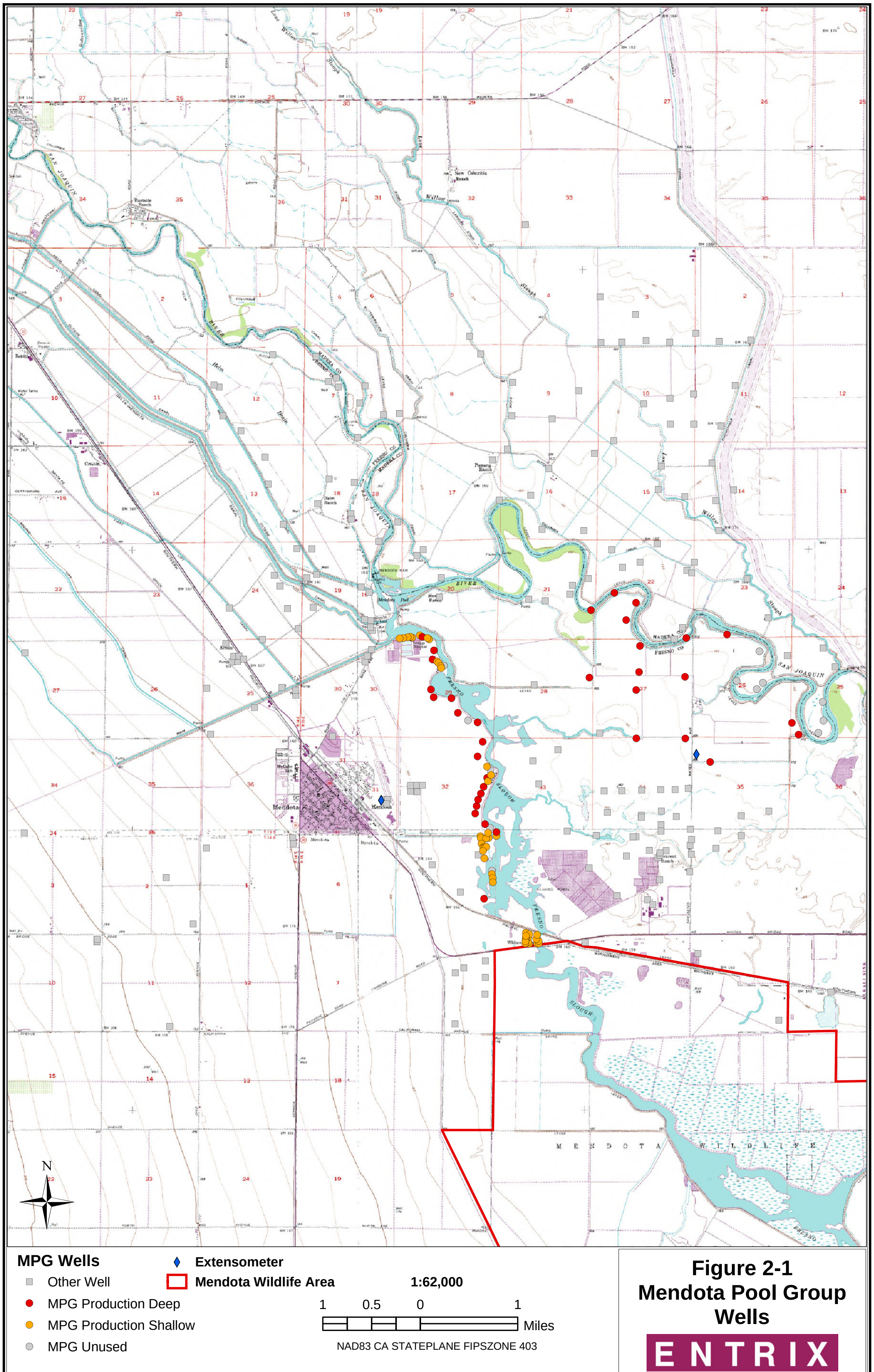

Figure 2-1
Mendota Pool Group Wells

ENTRIX

This section provides an overview of the current conditions of the environmental resources potentially affected by the proposed project or the alternatives. Information for this discussion was gathered from several sources: the 2002 Environmental Assessment (EA Number 01-83), Mendota Pool Exchange Agreements (Reclamation 2002), the 1999 Water Management Plan for Westlands Water District (WWD 1999), the 2000 Deep Groundwater Report for Westlands Water District (WWD 2001), technical reports on previous projects (KDSA and LSCE 2000a and 2000b, LSCE and KDSA 2001, LSCE and KDSA 2002), and the draft EIR for a previously proposed project (Jones and Stokes 1995).

The Proposed Action involves pumping groundwater into a surface water body (the Mendota Pool), with subsequent delivery to irrigated farmland and wildlife habitat. Water pumped into the Mendota Pool would be exchanged with Reclamation for water from the SLR and Canal. Therefore, the potentially affected resources in the project vicinity include:

- Groundwater
- Surface water
- Sediment
- Biological resources
- Central Valley Project facilities
- Archaeological and cultural resources
- Land use
- Traffic
- Noise

The socioeconomic characteristics of the area surrounding the project and populations that would be potentially affected are also discussed in this section.

3.1 AREA OF INTEREST

The area of interest for the evaluation of potential effects from the proposed project and alternatives is dependent on which primary environmental issue of concern is being addressed. The 1999 through 2002 monitoring programs have provided information with which to define the areas likely to be affected.

3.1.1 GROUNDWATER LEVELS AND SUBSIDENCE

The area of interest for evaluation of groundwater levels and subsidence was based on results of previous monitoring efforts and analyses. Based on existing data and modeling results, the groundwater level impacts from the proposed project during the pumping period are estimated to extend a maximum of 3.5 miles from the center of the MPG wells in FWD. This area represents the approximate center of the cone of depression created by MPG deep zone transfer pumping. For the purposes of this EIS, a conservative radius of 6 miles from the center of the cone of depression was selected as the area of interest for the proposed project, for both the normal and dry year pumping programs. This area of interest is shown on Figure 1-5. In wet years, when no transfer pumping would occur, there would be no water level impacts. The area of interest for the evaluation of subsidence resulting from the Proposed Action coincides with that for groundwater levels, as it is the change in groundwater levels due to pumping that is the primary cause of subsidence. In this analysis, subsidence is evaluated at two locations: the Yearout Ranch and Fordel Extensometers, located east and west of the Fresno Slough (Figure 2-1).

Under either of the No Action alternatives, the area of interest for groundwater levels would include areas of WWD and SLWD where new production wells would be installed. These wells would be located on lands owned by MPG members (Figure 1-2). The new wells would probably pump from the aquifer beneath the Corcoran Clay. The cones of depression resulting from pumping 25,000 acre-feet of water from these wells would depend on their depths and distribution among the MPG lands in WWD and SLWD. Subsidence due to inelastic compaction in and below the Corcoran Clay resulting from this pumping is a major concern for the No Action alternatives. The area of interest for subsidence for this alternative would also depend on the depth and location of the new wells.

3.1.2 Groundwater Quality

The area of interest for the evaluation of groundwater quality for the Proposed Action is smaller than that for groundwater levels, because groundwater quality impacts are expected to be more localized in the vicinity of the MPG well field. Groundwater quality has been evaluated primarily near the Fresno Slough and the San Joaquin River in the central and western portion of the study area used for evaluation of groundwater level impacts. Groundwater has not been evaluated south of Whitesbridge Road, because there are no known production wells in this area. Groundwater quality has not been evaluated in the eastern portion of the study area (east of the Chowchilla Bypass) because no impacts due to the project are anticipated in this area.

3.1.3 Surface Water Quality

The primary source of water for the Mendota Pool is the DMC. This project has no effect on the quality of the water delivered to the Mendota Pool by the DMC. Therefore, the starting point for water quality evaluations is the quality of the water at Check 21 near the DMC terminus (Figure 1-1). The Proposed Action would introduce groundwater into the Mendota Pool, the majority of which would be introduced into the Fresno Slough branch. Surface water is currently removed from the Mendota Pool via irrigation canals and pipelines located in both the northern and southern portions of the Mendota Pool. However, because groundwater would only be introduced into the Fresno Slough when flows in this branch of the Mendota Pool are to the south, any impacts on surface water quality will occur predominantly in the southern portion of the Mendota Pool. Some effects may be observed in the northern portion of the Mendota Pool as a result of pumping from the wells in FWD. This EIS evaluates changes in surface water quality as they potentially affect the irrigation districts (i.e., James ID, Tranquility ID, Fresno Slough WD, and Mid-Valley WD) and wildlife refuges that receive water from the Mendota Pool. The irrigation districts in the southern portion of the Pool do not discharge agricultural return water back to the Mendota Pool or any other water body, but let it infiltrate to groundwater.

Neither of the No Action Alternatives would introduce groundwater into the Mendota Pool or other water bodies, so there is no area of interest for surface water quality associated with them.

3.1.4 Sediment Quality

Sediment quality is influenced by the native substrate of which the sediment is composed and by inputs from overlying surface water. Impacts to surface water quality in the Mendota Pool from the proposed project can, therefore, also impact sediment quality. The area of interest for impacts to sediment quality is the same as for surface water. The No Action Alternatives would not affect surface water quality or sediment quality. This EIS evaluates potential effects of sediment quality on aquatic organisms that may be present in the Mendota Pool.

3.1.5 Biological Resources

Biological resources are considered to be primarily influenced by changes in surface water or sediment quality. Therefore, the area of interest for the evaluation of impacts of the proposed project on biological resources is coincident with the areas that are affected by changes in surface water quality. This area includes the Mendota Pool, irrigation canals and bordering lands, irrigated fields, and the MWA. As noted for surface water quality, limiting MPG pumping to periods when flow is to the south in the Fresno Slough effectively precludes movement of MPG water from wells along the Fresno Slough into irrigation canals in the northern portion of the Mendota Pool. Because the primary route of exposure to biological resources is through surface water, this evaluation will focus primarily on species associated with the water in the Mendota Pool, irrigation canals, and irrigated (or flooded) fields.

The No Action Alternatives would have different areas of interest. Neither option would result in changes to surface water quality or sediment quality. Installation of additional wells on lands farmed by MPG members in WWD and SLWD would maintain production on lands currently being farmed. Therefore, the area of interest would include MPG owned lands in SLWD and WWD, and adjacent areas.

3.1.6 Historic And Societal Resources

The area of interest for archaeological and cultural resources for the proposed project and the alternatives includes the Mendota Pool and the lands irrigated by the MPG. The area of interest for land use for the proposed project and the alternatives includes the lands irrigated by the MPG. The area of interest for traffic for the proposed project and the alternatives includes roads that provide access to the lands irrigated by the MPG. The area of interest for noise for the proposed project includes the areas near production wells owned and operated by the MPG. For the No Action Alternative option that includes construction of new production wells, the area of interest would include areas near the new well locations during construction and subsequent operation, as well as the areas near the existing MPG wells.

3.2 CLIMATE

Climate is the primary factor controlling water supply and water requirements throughout California. Most of California's water supply comes from precipitation in mountainous areas. Falling as rain or snow during the winter, it is held in reservoirs and as snowpack until needed during the growing season (Western Regional Climate Center [WRCC] 2002). Approximately 90 percent of California's water consumption is used for agriculture. Within the state, more than 70 percent of the streamflow is generated in the area north of Sacramento, while about 80 percent of the water demands occur south of this line. Thus, distribution of water is a major concern within California.

Typically, throughout California there are extended periods every summer with little or no precipitation. This is the normal and expected condition. Therefore, a shortage of irrigation water stored in reservoirs at the beginning of the season is serious, because normal summer precipitation is not sufficient to meet agricultural requirements. Precipitation deficiencies become critical in the state when the normal winter water supply fails to materialize.

The California Department of Water Resources classifies water year types based on runoff and storage in the Sacramento and San Joaquin Valleys. Data on water year types are available from 1901 to 2001 for the San Joaquin Valley and from 1906 to 2001 for the Sacramento Valley. Within each Valley, an index is calculated based on four major tributaries (DWR 2002a). The classification of a particular year is relative to other years in the same drainage.

The hydrologic year classifications of the Sacramento and San Joaquin River Basins are highly correlated between the two basins ($r = 0.89$). Each basin is characterized by approximately 35 percent wet years and 30 to 34 percent dry or critical years (Figure 3-1). The San Joaquin Basin has had a slightly greater percentage of above normal years, and more critical years than the Sacramento Basin. Although the two basins are very similar, the Sacramento River Basin index is used for water supply allocations to WWD, as the majority of the water storage is derived from the northern portion of the State.

The long growing season characteristic of most of the valley areas where agriculture is concentrated is an important factor in the production picture. The long dry period during the summer facilitates the planting, cultivation, and harvest of many crops, and isolated late spring, summer, or early fall rains sometime result in more damage than benefit to crops. In general, the distribution of temperature and precipitation is highly favorable for most agricultural enterprises as long as sufficient irrigation water is available (WRCC 2002).

Regional climate data were obtained from the WRCC and DWR for the Five Points weather station. The Five Points station is located approximately 25-30 miles south-southwest of Mendota (Figure 1-1). Annual precipitation at the Five Points climate station averages about 6.6 inches, the majority of which falls during the months of December through March (Table 3-1). Historically, total annual precipitation has varied from 2.9 inches to 14.6 inches per year. Average monthly maximum temperatures range from 55°F to 97°F, and average monthly minimum temperatures range from 36°F to 62°F. Summer maximum temperatures frequently exceed 100°F, and winter temperatures occasionally fall below freezing (WRCC 2002). With a mean annual temperature of 62°F, the area has an average frost-free growing season of 280 days (WWD 1999).

Evapotranspiration in the project vicinity is amongst the highest in California. DWR provides reference evaporation (ET_0) rates for over 100 sites as part of the California Irrigation Management Information System (CIMIS). The ET_0 is based on the evapotranspiration of turf grass and is used to estimate evapotranspiration rates for major crops. For the CIMIS stations closest to the Mendota Pool, the ET_0 averages 55.4 inches per year at the Firebaugh station and 58.8 inches per year at the WWD station near Tranquillity (DWR 2002b).

3.3 SURFACE WATER

The following discussion of surface water resources addresses the major components of the water storage and delivery system in the project area, the volumes of water moving into and out of the Mendota Pool, and the water quality of the Mendota Pool and adjoining canals.

3.3.1 SURFACE WATER DELIVERY AND DISTRIBUTION

Reclamation has contracts to deliver approximately 1.9 million acre-feet of water per year to users on the western side of the Central Valley. WWD's contract with Reclamation is for a maximum of 1,008,000 acre-feet per year, or approximately 53% of the total contracted amount. WWD began receiving CVP water in 1968 when the SLC was completed. WWD also has a contract for 250,000 acre-feet per year of litigation settlement water from the resolution of the Barcellos lawsuit. In most years, however, these deliveries are reduced to a fraction of the maximum contracted amounts because of drought conditions and, more recently, the federal ESA, the CVPIA, Central Valley Water Quality Control Plan, and other environmental concerns in and upstream of the Delta.

Surface water features in the southern Central Valley include Millerton Reservoir, SLR, the SLC, the DMC, the Mendota Pool, the San Joaquin River, Fresno Slough, James Bypass, Kings River, and Chowchilla Bypass (Figure 1-1). The SLR, DMC, SLC, San Joaquin River, Mendota Pool, and the WWD distribution system are key components of the proposed project.

3.3.1.1 San Luis Reservoir

The SLR is an offstream storage reservoir, with a gross storage capacity of 2,039,000 acre-feet (DWR 2002). The federal (i.e., CVP) portion of the storage capacity is 971,000 acre-feet. The reservoir receives exports of Delta water from the CVP and SWP systems. The SLR increases the operational flexibility of the CVP and SWP pumping plants, which are restricted from pumping during certain periods because of fishery and water quality concerns. During winter and early spring, water is pumped to the SLR from the DMC for storage and later release during the irrigation season. During the principal irrigation months, water at the O'Neill Forebay is diverted directly to the DMC and SLC without being pumped into the reservoir. Reclamation monitors water quality in the O'Neill Forebay (Check 13) on a monthly basis (B. Moore 2001, pers. comm.). Water from the MPG wells cannot be pumped directly to the San Luis Reservoir for storage.

Storage in the SLR shows a seasonal pattern corresponding to filling during the winter and release for use during the summer months. Typically, federal storage in SLR reaches its maximum in March-April of each year (Figure 3-2) (DWR 2002d). Minimum storage generally occurs in August. Between 1981 and 2002, the median available Federal storage in SLR in March-April was 15,900 acre-feet. Prior to 1991, available Federal storage was highly variable, since then available storage has been more uniform. Between December 2000 and March 2001, Federal storage exceeded its available capacity by up to 78,800 acre feet. However, available Federal storage in the reservoir has been at least 4,150 acre-feet in all other years.

3.3.1.2 San Luis Canal (California Aqueduct)

The SLC is the joint state-federal portion of the California aqueduct that extends from the O'Neill Forebay to the southern end of the San Joaquin Valley. The SLC is used to transport water to the west side of the San Joaquin Valley for use by CVP and SWP contractors (Interior 1999). SLWD and WWD divert water from the SLC for irrigation. The capacity of the Dos Amigos Pumping Plant, located downstream of the SLR, is 15,450 cfs. The Federal share of the plant capacity is approximately 7,357 cfs, or approximately 14,600 acre-feet per day (Kiteck 2002).

Monthly average flows in the Federal portion of the SLC between 1981 and 2002 are shown in Figure 3-3. The maximum Federal flow observed in this period was 5,272 cfs; the median flow was 1,337 cfs. Maximum Federal flows in the SLC generally occur in June to August. Typically, flows during the peak irrigation season (May to August) average 2,920 cfs, or approximately 40 percent of the maximum capacity. Available Federal capacity in the SLC ranges from 2,085 to 7,357 cfs as a monthly average, with a median value of 6,020 cfs.

3.3.1.3 Delta-Mendota Canal

The DMC is a CVP facility that conveys water from the Delta to the Mendota Pool and is the primary source of water to the Mendota Pool. Water from the Delta is diverted at the CVP Tracy Pumping Plant and conveyed 117 miles south to the Mendota Pool (Jones and Stokes 1995). The original design capacity of the DMC is 4,600 cfs at the Delta and 4,200 cfs at O'Neill Forebay (Check 13), decreasing to 3,200 cfs at the DMC terminus at the Mendota Pool. Current actual capacities are 4,600 cfs, 4,150 cfs, and 2,950 cfs, respectively.

Upstream of Check 13, the water in the DMC is used as both a domestic water source and for irrigation. At Check 13, water for domestic uses and irrigation is diverted to the SLR or SLC. Water that flows in the DMC downstream of Check 13 is used for agricultural purposes only. Water in the DMC is used to irrigate lands along the west side of the San Joaquin Valley and to replace some of the riparian diversions from the San Joaquin River that have been eliminated since the construction of Friant Dam (Millerton Reservoir). Some of the water delivered to WWD is conveyed to the Mendota Pool via the DMC, but WWD does not divert water from the DMC directly. WWD receives water from the Pool via Laterals 6 and 7.

3.3.1.4 San Joaquin River

The majority of flow in the San Joaquin River upstream of the Mendota Pool is diverted out of the San Joaquin River at the Friant Dam (Millerton Reservoir) (Figure 1-1). Construction and operation of Friant Dam and Millerton Reservoir in 1944 as part of the CVP and water diversions to the Friant-Kern and Madera Canal distribution systems essentially depleted flows in the San Joaquin River between Friant Dam and Mendota Pool. In general, the San Joaquin River is dry downstream of Gravelly Ford during most years, except during periods of heavy snowmelt and flood releases. Typically, releases from Friant Dam are only sufficient to provide minimal irrigation water supplies. Starting in 1999, additional water has been released intermittently from Friant Dam and discharged into the San Joaquin River in an effort to restore upstream riparian areas (CVRWQCB 2002). Water diversions for agricultural production throughout the valley, reduced natural streamflows, and discharges of subsurface agricultural drainage, municipal and industrial runoff, and surface return flows have had a major impact on San Joaquin River water quality below Friant Dam. Water quality ranges from good to poor depending on water conditions and the volume of drainage water. The river reach immediately below the Mendota Pool flows year round because of releases from the Mendota Dam to meet water rights of the San Luis Canal Company, one of the Exchange Contractors, at the Arroyo Canal (Jones and Stokes 1995).

Below the confluence with Bear Creek at Lander Avenue, elevated concentrations of salt and trace elements such as boron and selenium have been reported in samples from the San Joaquin River. The lower San Joaquin River watershed downstream of Mendota Dam to Airport Way Bridge near Vernalis (130 river miles) is listed as an impaired waterway under Section 303(d) of the Clean Water Act for salinity and boron, as well as other constituents. Water quality criteria for salinity (as EC) and boron at the Airport Way Bridge have been established. The portion of the San Joaquin River from Salt Slough to the Airport Way Bridge (50 river miles) is listed as an impaired waterway under Section 303(d) of the Clean Water Act for selenium.

3.3.1.5 Mendota Pool

The Mendota Dam is a non-federal facility owned and operated by the CCID. The dam is located downstream of the confluence of the San Joaquin River and Fresno Slough and forms the Mendota Pool (Figure 2-1). The Mendota Pool is generally considered to extend to the south past the MWA to the terminus of the James Bypass. In the San Joaquin River branch, the Mendota Pool extends almost to San Mateo Avenue. The Mendota Pool is generally less than 10 feet deep (G. Browning 2001, pers. comm.), and averages about 400 feet wide. The total capacity of the Mendota Pool is about 8,500 acre-feet (J. Martin 2001, pers. comm.).

The SLDMWA manages the Mendota Pool and maintains the water level in the Mendota Pool so that its contractors and prior water right diverters may redivert water imported via the DMC. Reclamation has contracts to deliver 936,631 acre-feet per year of water through the Mendota Pool. This water is diverted to the users by canals, pumping plants, and downstream releases to the San Joaquin River. Up to 840,000 acre-feet per year are used to replace San Joaquin River water that is diverted at Friant Dam. Reclamation also delivers water through the Mendota Pool to satisfy the prior rights of JID (45,000 acre-feet per year), Tranquillity Irrigation District (TID) (34,000 acre-feet per year), and the MWA (30,000 acre-feet per year), as well as a portion of the water contract for WWD (Jones and Stokes 1995). WWD can take up to 50,000 acre-feet of provisional CVP water per year from the Mendota Pool.

Most of the diversions from the Mendota Pool occur in the northern portion of the Fresno Slough branch north of Transect A-A' (Figure 3-4) by the SJREC. Transect A-A' is an artificial dividing line located east of the Firebaugh Intake Canal. This transect location is between the SJREC intake canals and the outlets of the northernmost MPG wells along the Fresno Slough. Flow direction in the Slough was monitored at this location in 1999. The Mendota Pool is drained approximately every other year by CCID to allow maintenance on Mendota Dam. The Mendota Pool was drained by CCID from late November 1999 until January 2000; and from late November 2001 until January 2002.

In order to clarify discussions of surface water in the Mendota Pool and groundwater near the Mendota Pool, it is necessary to define distinct areas. The following definitions take into account the surface water sampling stations and the locations of both MPG and non-MPG wells in the region. The Mendota Pool and lands near the Mendota Pool and the San Joaquin River discussed in this report are grouped into the following areas:

1. San Joaquin River branch of the Mendota Pool – This area encompasses the San Joaquin River from the eastern portion of the Mendota Pool (west of San Mateo Ave.) to its confluence with the Fresno Slough near Mendota Dam. This region includes the Columbia Canal surface water sampling station and the MPG wells in FWD, which pump into this branch of the Mendota Pool.

2. Northern Fresno Slough – This area extends from Mendota Dam south to the center of the MPG well field along the Fresno Slough (just north of Etchegoinberry). This includes the Dam, the DMC, the CCID Main and Outside Canals, and the Firebaugh Intake Canal. It also includes the northern portion of the MPG well field.

3. Central Fresno Slough – This extends from Etchegoinberry south to the northern boundary of the Five Star and Coelho West well fields adjacent to Whitesbridge Road (Highway 180). This area includes the southern portion of the MPG well field along the Fresno Slough. It also includes the Mendota Biomass production well.

4. Southern Fresno Slough – This encompasses all areas south of Whitesbridge Road and includes the MWA, Laterals 6 and 7, and the James Bypass. The Five Star and Coelho West wells located immediately north of Whitesbridge Road are also included in this region.

5. West of Fresno Slough – This area encompasses those lands that lie south of Bass Avenue and west of the MPG wells along the Slough. It includes the USGS well clusters, the Hansen Farms well, and the Meyers Farming monitoring wells S-1 to S-3.

6. East of Fresno Slough – This area encompasses those lands that lie south or west of FWD, and east of the Fresno Slough. The Spreckels Sugar Co. and B&B Ranch wells lie in this area.

7. North of Mendota – This area includes lands that are situated north of Bass Avenue (at the northern edge of the City of Mendota) and west of the Fresno Slough and the San Joaquin River. The City of Mendota, CCID, and Locke Ranch wells lie in this area.

8. North of San Joaquin River – This area is bounded on the south by the San Joaquin River branch of the Mendota Pool, on the west by the San Joaquin River downstream of Mendota Dam, and on the east by the Chowchilla Bypass. This area includes the NLF and CCC wells in Madera County.

9. East of Chowchilla Bypass – This area encompasses the eastern portion of the study area in both Madera and Fresno Counties. It includes portions of Aliso and Gravelly Ford Water Districts as well as undistricted areas.

3.3.1.6 WWD Distribution System

WWD supplies CVP water to farmers in the district through a 1,034-mile system of underground pipes varying from 10 inches to 96 inches in diameter. WWD maintains all conveyance facilities and equipment. Conveyance losses are small because of the closed system and intensive preventive maintenance. All water deliveries are measured by meters at the SLC and the Mendota Pool, at each diversion lateral, and at each field outlet. All meters are tested at least once every 4 years. Water is delivered to farmers based on water orders placed the previous day. At the scheduled time, a farmer opens the valve at the delivery point to obtain the approved flow (Jones and Stokes 1995).

The overall irrigation efficiency in WWD is estimated to be 83% (WWD 2001), which is highly efficient relative to many other irrigation districts in the San Joaquin Valley. Farmers are surveyed annually to determine the types of on-farm irrigation systems used. The available data through 2000 indicate that less than one-third of the district is irrigated by surface systems (furrows 28% and border strips 2%). The remaining farms use pressure systems (sprinklers 14% and drip irrigation 13%) or a combination of pressure and surface systems (sprinkler/furrow 43%) (WWD 2001). Currently, 29% of the surface-irrigated fields use tailwater (surface runoff) recovery and reuse systems (J. Robb, 2001, pers. comm.). Throughout WWD, no water is allowed to leave the water users' fields.

3.3.1.7 Mendota Pool Water Budget

Water quality conditions in the Mendota Pool are the result of the quantity and quality of the various inflows and outflows of water from the Delta (via the DMC), and intermittent inputs from the San Joaquin River, Fresno Slough, James Bypass, Panoche Creek, and seasonal groundwater pumping to the Mendota Pool. The major inflows and outflows considered in the water budget are shown in Figure 3-4. Inputs to the Mendota Pool shown on this figure include the DMC, the San Joaquin River, and the MPG wells.

Water budgets for 1997 through 2000 for the northern and southern portions of the Mendota Pool were prepared as part of the Phase I study report and the 2000 Annual Report (KDSA and LSCE 2000a, LSCE and KDSA 2001). A similar water budget for 2001 for the southern portion of the Mendota Pool was prepared as part of the 2001 Annual Report (LSCE and KDSA, 2002). Water budgets for the 1997 through 2001 irrigation seasons (May to September) are summarized in Table 3-2. The primary input in the southern portion of the Fresno Slough during wet years such as 1998 is the James Bypass, which shunts water from the Kings River to the southern end of Fresno Slough. The dominant water inputs to the Mendota Pool during the rest of the 1997 through 2001 came from the DMC, which accounted for over 80% of the total inflows. The primary outflows in the southern portion of the Mendota Pool are diversions by JID and TID, the MWA, and WWD (via Lateral 6 and 7). Seepage was estimated from measurements made over a 2-day period in November 1999, and is assumed constant.

Flows through the Mendota Pool show clear seasonal trends and are much larger during the summer months (except during periods of flood flows), although the timing and magnitude of the flows vary between years (Figure 3-5). The seasonal pattern is particularly evident in the northern portion of the Mendota Pool. Inflows to the northern Mendota Pool generally peak at approximately 3,000 cfs during the June-September time period. Measured outflows from the northern Mendota Pool were generally less than the inflows, with the exception of winter 1997 and spring 1998 when flood flows from the James Bypass into the southern Mendota Pool caused a northward flow in the Fresno Slough branch of the Mendota Pool. However, during most of the year, measured outflows from the southern Mendota Pool were generally greater than inflows. This pattern results in a net flow to the south in the Fresno Slough branch of the Mendota Pool for most of the year. Flow direction and magnitude across Transect A-A' is shown in Figure 3-5 for 1999 through 2001. During this period, only 10 short-term flow reversals (i.e., northerly flow events) were identified. The north flow events in November-December 1999 and November-December 2001 were due to deliberate draining of the Mendota Pool to allow the dam to be inspected.

During MPG pumping events, inflows from the MPG wells generally comprised less than 10% of the total inflows to the Mendota Pool. In 1999 and 2000, the MPG contribution averaged 1% of the total inflow during the spring, 4% during the summer, and 2% in the fall.

3.3.2 SURFACE WATER QUALITY

The MPG, in conjunction with NLF and the SJREC, has monitored water quality at 12 locations in the Mendota Pool and canals which divert water from the Mendota Pool (Figure 3-6) during the MPG pumping periods from 1999 through 2002. Surface water quality data obtained from the 2001 monitoring program and 2002 monitoring data through September 2002 are summarized in Table 3-3 for the primary parameters of concern. The sampling locations are generally listed in geographical order from northeast to south, and are grouped according to geographic region (San Joaquin River Arm, Northern Fresno Slough, Central Fresno Slough, and Southern Fresno Slough). Primary constituents of concern are salinity (as EC and/or TDS), arsenic, boron, molybdenum, and selenium, because of their potentially harmful effects on plants and wildlife. Samples were also analyzed for selected additional trace elements and general minerals. The surface water monitoring program is described in

Appendix B. Complete surface water quality results for 1999 through 2001 are summarized in Appendix C. Where a chemical constituent was not detected in a sample, the value is shown as less-than the analytical reporting limit (e.g., <0.4 μg/L).

Surface water quality criteria or guidelines were identified for water quality constituents of concern. Criteria were identified for arsenic, boron, molybdenum, selenium, TDS, and EC. Beneficial uses of surface water for which criteria or guidelines were identified include irrigation water, drinking water, wildlife refuge habitat, and aquatic life. For surface water, the following documents were reviewed:

- The Fourth Edition of the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins (CVRWQCB 1998)

- The Second Edition of the Water Quality Control Plan (Basin Plan) for the Tulare Lake Basin (CVRWQCB 1995)

- The U.S. EPA National Recommended Ambient Water Quality Criteria (AWQC) for freshwater aquatic life protection as reported in Marshack (2000)

- The preliminary draft water quality criteria for refuge water supplies developed by the Central Valley RWQCB (1995)

- Selenium ecological risk guidance provided by Reclamation in "Appendix E2 of the Draft Grassland Bypass Project Environmental Impact Statement and Environmental Impact Report Volume II" (Reclamation 2000)

- The FAO Irrigation and Drainage Paper No. 29, "Water Quality for Agriculture" (Ayers and Westcot 1985)

The criteria listed in Table 3-4 represent the most conservative (lowest) values reported in the reviewed documents, and care was taken to select those criteria that are most appropriate for the Mendota Pool area.

The following sections discuss the 2001 and available 2002 surface water quality data for arsenic, boron, molybdenum, selenium, and salinity (Table 3-3). Other water quality parameters, including chloride and sulfate, are closely related to salinity and would be expected to behave similarly to salinity; these are not evaluated further in this EIS.

3.3.2.1 Arsenic

The MPG began to analyze Mendota Pool surface water samples for arsenic in 2001, at the request of CDFG, primarily in the southern portion of Fresno Slough. At least one sample from each station was analyzed for arsenic (Table 3-3). The detection limit was 2 μg/L except for the July 2001 samples, which were analyzed with a detection limit of 3 μg/L. Arsenic was tested for the first time at the Columbia Canal intake (on the San Joaquin River Arm of the Pool) in June 2002 and was detected at 3 μg/L.

Sampling stations in the Northern Fresno Slough include the Mendota Dam, CCID Main Canal, Mowry Bridge, DMC Check 21, CCID Outside Canal, Firebaugh Intake Canal, and West of Fordel. Arsenic was detected at or near the reporting limit in seven of 22 samples tested in the Northern Fresno Slough. Arsenic was detected at least once at all stations except the CCID Outside Canal. Of the seven detects, five were in samples collected in June 2002.

Etchegoinberry is the only station in the central Fresno Slough. Arsenic was not detected in a sample collected in November 2001, but was detected at 3 μg/L in June 2002.

In the Southern Fresno Slough, data are available for MWA, Lateral 6&7, and JID (Booster Plant) stations. Of the 22 samples tested from these three stations, arsenic was detected in 12 samples. Detected levels were generally 4 μg/L or less, with one sample (5/30/2001) at the JID station containing 10 μg/L. Other arsenic concentrations at this station in 2001 and 2002 ranged from <2 to 3 μg/L. Therefore, the value of 10 μg/L is considered anomalous.

Of the beneficial uses identified for surface water, the lowest benchmark for arsenic is 10 μg/L (aquatic life protection, Table 3-3). CDFG recommends a target level of 5 μg/L arsenic in water supplied to the MWA, with a toxicity level of 10 μg/L. Arsenic concentrations in surface water were less than 5 μg/L in all but one sample collected in the Mendota Pool in 2001 and 2002.

3.3.2.2 Boron

Water samples have been analyzed for boron since 1999 at most surface water sampling stations. Appendix C includes all available boron data for surface water stations in the Pool. Table 3-3 includes available data from 2001 and 2002, which are discussed in this section. Three samples were collected at the Columbia Canal station in the San Joaquin River arm of the Mendota Pool in 2001 and 2002. Boron concentrations ranged from 0.16 to 0.2 mg/L in the three samples.

In the Northern Fresno Slough, 33 samples were collected from the seven sampling stations, and boron was detected in 27 of the samples. Concentrations ranged from 0.13 to 0.25 mg/L, with an average detected concentration of 0.19 mg/L. Boron concentrations in 2002 samples were lower than those collected in 2001.

At Etchegoinberry in the Central Fresno Slough, boron was detected at 0.3 mg/L in November 2001 and at 0.18 mg/L in June 2002.

In 2001, samples were collected every month except September and December from the Southern Fresno Slough stations. Samples were collected three or four times during the pumping period in 2002 at these stations, and for one sample collected at TID Intake in September. Concentrations ranged from 0.13 to 1.29 mg/L (this reading was from the TID sample). The average concentration of these 43 samples was 0.29 mg/L. Excluding the TID sample, boron ranges from 0.13 to 0.41 mg/L, with an average concentration of 0.29 mg/L. Boron concentrations in the Southern Fresno Slough are similar in 2001 and 2002 for similar sampling dates.

The target level recommended by CDFG for boron for the MWA is 0.3 mg/L. Samples collected at the MWA in the spring of 2001 (February through May) and in November 2001 slightly exceeded this level, with the highest concentration (0.41 mg/L) occurring in April. MPG transfer pumping did not start until mid-May in 2001, and continued until mid-November prior to the Pool being drained. The boron concentrations recommended by CDFG are based on the water quality standards for the San Joaquin River at Vernalis and are lower than the criteria for other identified beneficial uses of Mendota Pool water.

3.3.2.3 Molybdenum

Analysis of surface water samples for molybdenum began in 2001 at the request of CDFG. Molybdenum was first tested in 2002 at the Columbia Canal intake, and was detected at 5.1 μg/L.

Molybdenum data were collected at the seven Northern Fresno Slough stations in 2001 and 2002. Results indicate that molybdenum concentrations in the northern Slough ranged from <1.0 to 4.2 μg/L (Table 3-3). Except for the CCID Main Canal station, molybdenum concentrations were lower in 2002 than in 2001.

At the Etchegoinberry station in the central Slough, molybdenum was detected at 4.1 μg/L in 2001 and at 2.4 μg/L in 2002.

At the three stations in the southern Slough, molybdenum ranged from 1.0 to 8.4 μg/L, with lower concentrations measured in 2002 than in 2001.

All molybdenum concentrations were less than the target level recommended by CDFG for the MWA (10 μg/L), and much lower than the criterion for aquatic life protection of 19 μg/L. Molybdenum criteria have not been established for drinking water or irrigation uses.

3.3.2.4 Selenium

As reported in the 2002 EA (Reclamation 2002), analytical data for selenium collected prior to June 2001 were not of adequate quality to be usable for comparing selenium concentrations to water quality guidelines. The detection limits were not low enough, and the method used for analysis was subject to interference. Because of these factors, it is possible that there were false positives, elevated concentrations, and false negatives reported for selenium prior to June 2001. To provide better accuracy in the evaluation of surface water quality, samples analyzed by laboratories other than Olson Biochemistry Laboratories, Frontier Geosciences, or Reclamation are not included in Table 3-3, nor are they included in the evaluation of selenium concentrations in surface water. (All available selenium data for surface water are included in Appendix C.)

Selenium was detected at low concentrations (3.32 μg/L or less) in 48 of 55 samples collected in 2001 and 2002 at stations in the northern Slough and analyzed by Olson Biochemistry Laboratories or Reclamation (Table 3-3). Selenium concentrations have been monitored by Reclamation at Check 21 on the DMC on a monthly basis since 1994, and in the CCID Main and Outside Canals since 1999 (B. Moore 2001, pers. comm.) (Figure 3-8).

Detected concentrations at DMC Check 21 ranged from 0.5 to 3.32 µg/L. Samples from the CCID Outside Canal ranged from non-detect (<0.4 µg/L) to 2.69 µg/L. Samples from the CCID Main Canal ranged from <0.4 µg/L to 2.96 µg/L. Selenium concentrations at the CCID canals tracked those of the DMC fairly consistently over the period evaluated. This is expected because most of the water diverted by the CCID canals enters the Mendota Pool via the DMC. The highest selenium concentration detected in 2002 in the northern Slough was 1.19 µg/L at the DMC Check 21 in June 2002. Most selenium concentrations were less than 1.0 µg/L in 2002.

Data collected in 2001 at the Columbia Canal intake on the San Joaquin River arm of the Pool are not of adequate quality for this evaluation. Data collected in June 2002 are of adequate quality; selenium was detected at 0.71 µg/L at this station.

At Etchegoinberry (central Slough), selenium was measured at 0.47 µg/L in November 2001 and at 0.67 µg/L in June 2002.

At the three southern Fresno Slough stations, selenium was detected in 12 of 13 samples analyzed by Olson Biochemistry Laboratories at concentrations ranging from 0.048 to 0.95 µg/L.

The detected levels at the southern Slough stations are two orders of magnitude lower than drinking and irrigation water criteria, which are both 50 µg/L. The criterion for protection of aquatic life and the CDFG recommended target level for the MWA are both 2 µg/L. No selenium concentrations measured in the Mendota Pool in 2002 exceeded this target level.

3.3.2.5 Salinity (as TDS)

Grab surface water samples are collected monthly at the CCID Main Canal and DMC Check 21, and during and at the end of the pumping season at the other stations. Results of grab samples collected in 2001-2002 are summarized in Table 3-3. In addition to collection of surface water grab samples at 13 locations around the Mendota Pool, EC is currently monitored using continuous recorders at Check 21 near the DMC terminus and at the intakes to the CCID Main Canal, CCID Outside Canal, Columbia Canal, the Firebaugh Intake Canal, and the MWA (starting in 2002).

TDS concentrations in the Mendota Pool (either measured directly or estimated from EC data) vary widely and are seasonally influenced. At the Columbia Canal intake, TDS was measured once at 240 mg/L (6/25/2002). TDS results for surface water stations in the Northern Fresno Slough ranged from 210 to 479 mg/L in 2001-2002. At the Etchegoinberry station in the Central Slough, TDS was measured at 500 mg/L in November 2001 and at 280 mg/L in June 2002. Measured TDS concentrations in the southern Slough ranged from 280 mg/L at the MWA in July 2002 to 1,080 mg/L at the TID intake station in September 2002. TDS tends to be higher in the Southern Fresno Slough region. TDS measured at MWA, Lateral 6 & 7, and JID stations were generally lower in July-September 2002 than in the same period in 2001.

Reclamation has monitored EC at the terminus of the DMC since 1965. Based on 37 years of daily data (1965 – 2001), the average EC at the terminus of the DMC is 618 μmhos/cm. EC measurements tend to be highest in the spring, lowest during the early summer (June - July), and increase steadily through the fall. Variability can be seen between water year types with the dry years tending to have the highest EC values during the summer, followed by normal and wet years. Normal water years tend to have higher EC measurements in the winter and spring than the other classifications.

EC concentrations in the Pool are highly variable over time and generally track the concentrations in the DMC. EC data from the DMC terminus are converted to TDS concentrations using a regression equation derived from the relationship between EC and TDS measured in surface water samples from the Mendota Pool in 2000-2001.

The daily mean EC values at the terminus of the DMC for the period from January 1999 through October 15, 2001 are plotted on Figure 3-9. The daily mean EC ranged between 285 and 1,256 μmhos/cm, and averaged 483 μmhos/cm between January 1999 and October 2001.

Figure 3-9 shows the daily mean EC value at each of the five SJREC canal intakes from February 2000 to September 2001. The variation between the intakes averages 99 μmhos/cm, and ranges from 3 to 414 μmhos/cm. This variation is greatest during the spring months. Throughout most of the summer and fall months, differences between the daily average EC at the various intakes are relatively small. Water quality at the canal intakes generally tracks that of the DMC.

Certain canal intakes exhibited short-term elevated EC values as compared to the DMC. Daily average EC readings at the DMC were subtracted from concurrent daily average readings at the SJREC canal intakes to determine the magnitude of the deviations. The calculated deviations from the DMC for both the 2000 and 2001 pumping periods and non-pumping periods are summarized in Table 3-5. Negative values indicate that the EC at the canal intake is lower than the EC at the DMC. Both during the MPG pumping periods and periods when the MPG wells were not pumping, the range of deviations at all of the canals bracketed zero. The average deviations for the CCID Main Canal and the Firebaugh Intake Canal showed slightly poorer water quality (i.e., increased EC) during the MPG pumping period, the average deviation for the Columbia Canal showed slightly better water quality, and the CCID Outside Canal showed no difference. The observed deviations are variable and do not show any consistent pattern during MPG pumping periods.

The sodium absorption ratio (SAR) was calculated for those samples in which sodium, calcium, and magnesium were measured. The SAR provides an indication of the influence of salts in the water on soil permeability (Stromberg, undated). The SAR must be evaluated together with the salinity of the water to determine if the salt concentrations would be expected to impact the infiltration rate. A high SAR value will not impact the infiltration rate if the salinity of the water is also high. In *Water Quality for Agriculture* (Ayers and Westcot 1985), water is grouped into three classes (no restriction, slight to moderate restriction, and severe restriction) based on the degree of impairment for irrigation purposes due to the combined SAR and salinity values.

In the San Joaquin arm of the Mendota Pool, a SAR value of 1.6 was calculated in June 2002 (Table 3-3). SAR values ranged from 0.1 to 3.6 in the northern Slough region in 2001-2002. At the central Slough station, SAR values were 4.7 and 1.9 in November 2001 and June 2002, respectively. In the southern Slough, SAR values ranged from 0.1 to 12.2. The 12.2 SAR value was from TID. The highest value at the other three southern Slough stations was 6.4 at JID in April 2001. At the MWA, SAR values ranged from 0.1 to 6.2. All of these SAR values are relatively low, but the salinity of the samples was also low. Therefore, all of the surface water samples would be classified as slightly to moderately impaired for irrigation use based on SAR. Based on salinity alone (measured as TDS), 60% of the samples would be classified as non-impaired and 40% as slightly to moderately impaired.

The lowest water quality criterion for TDS is a target level of 400 mg/L as a 5-year average for Refuge Water Supply (Table 3-4). The 1-year average target level is 450 mg/L, and the monthly average is 600 mg/L. TDS at the MWA exceeded 600 mg/L in two samples collected in 2001 and in none of the samples collected to date in 2002. The 1-year TDS average based on grab samples was 501 mg/L in 2001, and in 2002 to date is 398.1 mg/L.

3.3.2.6 Summary of Surface Water Quality

The DMC is the primary/dominant source of surface water in the Mendota Pool, and therefore largely controls the water quality. There appears to be a north to south gradient in water quality in the Fresno Slough in concentrations of TDS/EC, boron, and molybdenum. In general, surface water quality was better in 2002 than in 2001, as indicated by lower concentrations of most target constituents.

3.4 GROUNDWATER SYSTEM

3.4.1 REGIONAL HYDROGEOLOGY

The proposed project is located within the San Joaquin Valley, which represents the southern two-thirds of the Central Valley, a structural trough about 400 miles long and 50 miles wide (WWD 1996). This trough is filled with thousands of feet of unconsolidated alluvial and marine sediments, the top 2,000 feet of which includes the aquifers penetrated by almost all water wells in the area. Streams and rivers flowing out of the adjacent mountains on both the east and west deposited the alluvial sediment, which varied in composition from coarse sand and gravel to fine silt and clay. As the alluvial sediments in the trough accumulated, the San Joaquin Valley occasionally contained large lakes or seas that resulted in the deposition of laterally extensive clay layers.

The Sierra Nevada, California's largest mountain range, borders the east side of the San Joaquin Valley and is predominantly composed of uplifted granitic rock overlain in areas by sedimentary and metamorphic rock. Alluvial deposits resulting from the erosion of the Sierra Nevada consist primarily of well-sorted sands, with minor amounts of clay. Within the San Joaquin Valley, this alluvium decreases in thickness and increases in depth below the surface toward the west. These coarse-textured sediments are characterized by high permeability and a low concentration of water soluble solids.

The Diablo Range of the California Coast Ranges borders the west side of the San Joaquin Valley and consists of complex, folded, and uplifted mountains that are composed predominantly of sandstones and shales of marine origin. These sandstones and shales contain salts, as well as trace elements such as selenium. Sediments eroding from these mountains form gently sloping alluvial fans. The texture of these deposits depends on their relative position on the alluvial fan, but generally grades from coarse sand and gravel close to the mountains to fine silt and clay to the east. The fine textured sediments are characterized by low permeability and increased concentrations of water soluble solids, primarily salts and trace elements. The alluvial sediments from both mountain ranges interfinger extensively in the western half of the trough.

One of the principal subsurface hydrogeological features of the San Joaquin Valley is the Corcoran Clay formation. Formed as a lake bed about 600,000 years ago, this clay layer ranges in thickness from 20 to 200 feet and occurs throughout all but the eastern and western margins of the San Joaquin Valley at about 300 feet below sea level. Varying in depth from 300 to 500 feet in the Valley trough to 850 feet along the Diablo Range, the Corcoran Clay divides the groundwater system vertically into two major aquifers, a lower, confined aquifer system and an upper, semi-confined aquifer system.

In addition to the clay layers centered around the Tulare Lake bed, the central axis of the San Joaquin Valley is capped by surficial flood-basin deposits created by geologically recent flooding along the San Joaquin River and Fresno Slough. Although these deposits are generally only 5 to 35 feet thick, their fine texture and low permeability greatly restrict downward movement of water, including seepage from overlying surface water bodies such as the San Joaquin River, Fresno Slough, and the Mendota Pool.

3.4.2 MENDOTA POOL AREA

As within most of the San Joaquin Valley, the Corcoran Clay divides the groundwater system in the Mendota Pool area and WWD vertically into an upper semi-confined aquifer system, and a lower, confined aquifer system, separated by the Corcoran Clay. Near the Mendota Pool, groundwater pumping occurs primarily from the upper semi-confined aquifer.

3.4.2.1 Upper Aquifer System

Near the Mendota Pool, most of the wells are completed entirely above the Corcoran Clay and, therefore, almost all of the groundwater pumped in this area is from the upper, semi-confined aquifer system. Although there are several clay layers of sufficient thickness and continuity to substantially impede vertical movement of groundwater in the upper aquifer system in the general vicinity of the Mendota Pool, the clay layer that creates the greatest limitation on vertical groundwater flow is a shallow, subsurface clay layer usually 10 to 15 feet thick that is identified frequently in the lithologic logs from wells near the Mendota Pool. This layer has been termed the A-clay and acts as a confining bed between the shallow and deep portions of the aquifer system overlying the Corcoran Clay. In the Mendota Pool area, the A-clay is generally encountered at depths between 70 and 100 feet below ground surface. This clay is locally missing in some areas and is commonly present in two layers in the area east of the Fresno Slough. The A-clay pinches out to the west near the Mendota Airport and to the east, east of San Mateo Road.

Vertical flow between the shallow and deep water-bearing zones of the upper aquifer system is limited by the vertical hydraulic conductivity of the A-clay (where it is present) and other shallow clay layers. The vertical hydraulic conductivity for the A-clay was estimated to be 0.024 gpd/ft^2 (KDSA 1989) in City of Mendota wells Nos. 3 and 4. Near the San Joaquin River branch of the Mendota Pool, groundwater quality in the shallow water-bearing zone is good due to recharge from the Mendota Pool. In areas west of the Fresno Slough, however, the quality of the shallow groundwater is poor. The shallow groundwater quality improves near the Slough and is better at the northern end of the Slough.

Wells primarily completed in strata above the A-clay, or the equivalent depth of this clay (generally less than 130 feet), are termed "shallow" in this EIS. Wells completed in strata below the A-clay, or its equivalent depth, but above the Corcoran Clay, are termed "deep". The majority of the MPG wells along the Fresno Slough branch of the Mendota Pool are shallow. All MPG wells along the San Joaquin River arm of the Mendota Pool are deep.

3.4.2.2 Lower Aquifer System

The lower aquifer system is the confined zone beneath the Corcoran Clay, which is considered to be continuous throughout the Mendota area. The Corcoran Clay acts as a relatively effective barrier to vertical flow between the upper and lower aquifers due to its thickness and low permeability. In the vicinity of the Mendota Pool, no production wells are screened entirely in the lower aquifer, although there are a few "composite" wells (screened above and below the Corcoran Clay) near the San Joaquin River branch of the Mendota Pool. The number of composite wells increases east of the Chowchilla Bypass, especially in Madera County, and there is a significant amount of pumpage from the lower aquifer in this area.

At the USGS monitoring well cluster west of the Mendota Airport, monitoring well 31J6 is completed below the Corcoran Clay. Even though most of the pumpage in the Mendota area is from the upper aquifer, water levels are considerably lower below the Corcoran Clay due to pumpage from the lower aquifer both east and west of the Mendota area. The downward vertical gradient across the Corcoran Clay averaged 0.8 foot/foot at this location in 2001.

3.4.2.3 Hydraulic Connection between Surface Water and Groundwater

The hydraulic connection between surface water in the Mendota Pool and groundwater differs between the Fresno Slough and the San Joaquin River arms of the Mendota Pool. Since at least the late 1980s, an unsaturated zone has apparently been present beneath the Fresno Slough branch of the Mendota Pool and was initially caused by drought conditions as well as geologic factors (Woodward-Clyde Consultants 1994). These factors include the presence of a clay layer beneath the Mendota Pool and the accumulation of silts and other fine sediments on the bottom of the Mendota Pool.

The shallow clay layer observed near the Fresno Slough branch by earlier investigators would limit the percolation rate of water from the Slough and reduce the effect of groundwater pumping on percolation even during periods when there is a direct hydraulic connection between shallow groundwater and surface water in the Slough (Jones and Stokes 1995). Furthermore, the Slough has accumulated a bed of clay and silt since Mendota Dam was constructed in 1863 that would also limit percolation (Jones and Stokes 1995). Much of the silt may have been carried in from the DMC after its construction in 1951. Contour maps of shallow groundwater levels produced by KDSA and LSCE (2000a) show no evidence of a groundwater mound beneath the Slough even when no shallow pumping is occurring, indicating the absence of a direct hydraulic connection between the Slough and shallow groundwater.

Prior to the installation of shallow monitoring wells near the San Joaquin River arm of the Mendota Pool by NLF in 1999, data were not available to determine the degree of hydraulic connection in this area. Based on data from the shallow monitoring wells, the shallow groundwater contour maps show a groundwater mound beneath the San Joaquin River arm of Mendota Pool. The presence of this mound and the relatively shallow groundwater water levels in these monitoring wells suggest that a direct connection between surface water and groundwater exists in this area. This may be partially the result of the reestablishment of summer flows in this portion of the San Joaquin River in 1999 and 2000.

Water level data from shallow NLF monitoring wells indicate that deep zone pumping in NLF and FWD has only a minimal effect on the shallow portion of the upper aquifer, due to the presence of confining layers such as the A-clay. MPG pumping from the deep zone is therefore unlikely to cause significant seepage from the San Joaquin River.

3.4.2.4 Groundwater Levels

Groundwater levels in a large number of wells in the Mendota area have generally been monitored at least bimonthly by the MPG and NLF since 1999. Historical water level data are also available for some wells. Both the recent and historical data have used to create groundwater elevation contour maps and water level hydrographs. Groundwater contour maps created since 1999 indicate that the areal extent of drawdowns caused by MPG shallow pumping is generally limited to the vicinity of the well field along the Fresno Slough, because the shallow aquifer is primarily unconfined. These drawdowns do not extend as far north as the San Joaquin River. Deep zone drawdowns extend much further from the pumping wells, because the deep zone is more confined. Drawdowns simulated with the deep zone groundwater model are estimated to extend a maximum of 3.5 miles from the center of the MPG wells in FWD.

Hydrographs of wells included in the monitoring program indicate that, at present, groundwater overdraft is not occurring in the Mendota area. Overdraft has occurred for decades in western Madera County south of the Chowchilla area, however. The overdraft is indicated by steadily declining groundwater levels in wells monitored by Reclamation and DWR. The approximate location of this overdrafted area is indicated by the cone of depression shown on groundwater elevation contour maps prepared by DWR (Figure 3-10). In 1989, the center of this cone of depression was located approximately 10 miles north of the San Joaquin River. By 1999, the cone of depression had expanded in a southerly direction so that the center was only about 8 miles north of the River. The expansion of the cone of depression is primarily due to additional wells and increased pumping resulting from land use changes in the area during the past decade. During this period, a significant amount of acreage was converted from native vegetation and crops such as grain to crops such as almonds, grapes, and alfalfa, which have much higher water requirements. Most of this area has limited surface water rights and relies primarily on groundwater. Increased pumping in the area causes overdraft due to geologic conditions and the lack of any major surface water features to provide groundwater recharge. The affected area is primarily east of the Chowchilla Bypass, but lack of full recovery in the northernmost NLF wells in recent years, indicates a potential for overdraft to occur in the northern portion of the study area.

3.4.2.5 Lateral Groundwater Flow

The natural direction of groundwater flow in the Mendota area is toward the San Joaquin River and Fresno Slough from both directions (east and west). Since the San Joaquin River flows in a northwesterly direction north of Mendota, the regional groundwater flow direction is generally to the northwest under natural conditions. Drawdowns caused by wells located near the San Joaquin River usually extend on both sides of the River, i.e., drawdowns caused by wells in Madera County extend into Fresno County and drawdowns caused by wells in Fresno County extend into Madera County. Groundwater flow directions can be inferred from regional groundwater elevation contour maps produced by DWR. A recent groundwater contour map for the Madera groundwater basin, obtained from DWR (Spring 1999) is shown on Figure 3-10. Similar to maps for previous years, this map shows a large cone of depression in western Madera County east of the Chowchilla Bypass. The DWR maps probably exaggerate the depth and areal extent of this cone of depression, because data from a number of composite wells (completed above and below the Corcoran Clay) are used for contouring in this area. This map suggests that the majority of the groundwater that flows into overdrafted areas of western Madera County comes from the southeast, where it originates as recharge from the San Joaquin River east of Gravelly Ford. The San Joaquin River below Friant Dam generally has flow only as far west as Gravelly Ford, and this is a losing reach of the river (i.e., the river stage is higher than shallow groundwater levels so that recharge from the river flows to the shallow aquifer). The riverbed is very permeable in this area, and the volume of groundwater recharge is relatively large. The Fresno River north of the cone of depression also provides groundwater recharge when it is flowing.

The cone of depression in the overdrafted areas of Madera County results in groundwater flow into these areas from all directions. North of Mendota Dam, this cone of depression is largely responsible for the northeasterly direction of groundwater flow on the east side of the San Joaquin River and steeper gradients west of the River. East of Mendota Dam, a groundwater divide exists beneath the San Joaquin River (Figure 3-10) North of the San Joaquin River, groundwater flows north into the overdrafted portion of western Madera County. South of the San Joaquin River, groundwater flows southeast into a similarly overdrafted area in Fresno County near Raisin City.

3.4.3 Westlands Water District

3.4.3.1 Upper Aquifer System

The upper aquifer system in WWD is the semi-confined zone above the Corcoran Clay. Salinity of the groundwater in the upper aquifer system is frequently higher than desirable for irrigation use (Jones and Stokes 1995). Few production wells pump from this zone, so limited groundwater level data are available. The groundwater flow direction in this zone during 1987 to 1993 was generally northeastward, from the foot of the Coast Ranges toward the valley trough (Jones and Stokes 1995). The upper aquifer system in WWD corresponds stratigraphically with the upper aquifer system east of WWD.

3.4.3.2 Lower Aquifer System

Most production wells in WWD are screened in the lower aquifer (i.e., below the Corcoran Clay). Groundwater quality in the lower, confined aquifer varies with depth throughout the District. The thickness of the lower aquifer ranges from about 200 feet in the Mendota area to over 2,000 feet in the western portion of WWD (Bull and Miller 1975).

The lower water-bearing zone is recharged by subsurface inflow from the east and northeast, percolation of groundwater, and imported and local surface water. The Corcoran Clay separates the upper and lower water-bearing zones in the majority of the District. The Corcoran Clay is not continuous west of Huron. Typically, water quality varies with depth, with the poorest quality occurring at the upper and lower limits of the aquifer and the optimum quality somewhere between. The upper limit of the aquifer is the base of the Corcoran Clay. The USGS identified the lower limit as the base of the fresh groundwater. The quality of the groundwater below the base of fresh water exceeds 2,000 parts per million total dissolved solids. WWD has tracked changes in groundwater elevations relative to groundwater pumping since 1976 (Table 3-6) (WWD 2002). Groundwater elevations have declined when pumping exceeded 160,000 to 175,000 acre-feet per year. WWD does not supply groundwater to District farmers nor does the District regulate or control groundwater pumping; individuals pump their own groundwater. However, WWD surveys the static water levels in the wells and the water quality and quantity of the pumped groundwater, as part of its Groundwater Management Plan (WWD 1996). Recent analysis of the groundwater level data indicates that the estimated safe yield may be between 135,000 and 200,000 AF per year (WWD 1996).

3.4.4 Land Subsidence

Land subsidence is defined as the lowering of the ground surface over a large area, in this case as a result of lowered groundwater levels due to groundwater pumping. Land subsidence in the San Joaquin Valley has been caused primarily by inelastic compaction of silt and clay layers and is most likely to occur in lacustrine deposits such as the Corcoran Clay. Other deposits such as the Coast Range alluvium (Diablo alluvial fan and flood plain deposits) also contain high percentages of these fine-grained sediments and are relatively compressible. Inelastic compaction of the silt and clay layers occurs relatively slowly and can continue for years after water levels have stopped declining.

Much less compaction occurs in coarser-grain sediments such as the Sierran sands along the east side of the Valley. This formation also contains interbedded silt and clay layers, but the sand layers are predominant. Compaction in this formation tends to be primarily elastic and is much less likely to cause irreversible subsidence. Elastic compaction and expansion of the coarse-grained sediments occurs relatively instantaneously in response to water level changes.

3.4.4.1 Mendota Area

The following discussion of land subsidence is based largely on the analysis presented in the Phase II report "Long Term Impacts of Transfer Pumping by the MPG" prepared by KDSA and LSCE (2000b) and the 2000 and 2001 annual monitoring reports (LSCE and KDSA 2001 and 2002).

Most subsidence in the Mendota Pool area has been the result of regional pumping from the lower aquifer below the Corcoran Clay. Even though this pumping occurs primarily west, southwest, and northeast of Mendota, it has historically caused water-level declines and compaction in the Corcoran Clay and other clays in the Mendota area. Water levels below the Corcoran Clay have generally been recovering in the Mendota area since the late 1960's, when groundwater pumping decreased after surface water supplies became available from the SLC.

In the Mendota area, almost all of the groundwater pumping is from the aquifers above the Corcoran Clay, which are composed primarily of Sierran sands. The generally elastic nature of compaction in this formation is evidenced by historical compaction data collected by DWR between 1966 and 1982 at the Yearout Ranch extensometer, which is located east of San Mateo Avenue just south of FWD (Figure 2-1). Historical data from the Yearout Ranch extensometer were analyzed by KDSA and LSCE (2000b) to determine the correlation between water-level changes and measured compaction that would allow prediction of future compaction at this location. Compaction and water levels above the Corcoran Clay at the Yearout Ranch site were measured continuously for a 17-year period (1966 to 1982). The annual rate of compaction was relatively constant from 1966 to 1977 and closely followed the trend of the lowest water levels, which declined from about 70 feet to almost 100 feet during this period. The total inelastic compaction above the Corcoran Clay between 1966 and 1982 was reported to be 0.265 foot, and there is evidence that approximately 0.25 foot of additional compaction above the Corcoran Clay may have occurred at the Yearout Ranch site between 1982 and 1999. The majority of the subsidence due to drawdowns of less than approximately 35 feet in the upper aquifer system has already occurred. As a result, compaction due to drawdowns less than 35 feet at Yearout Ranch is thought to be primarily elastic and reversible as the water table recovers each winter.

In 1999, the SJREC re-initiated data collection at the Yearout Ranch extensometer, and the MPG installed a new extensometer west of the Mendota Airport at Fordel, Inc. Recent data indicate that subsidence due to inelastic compaction above the Corcoran Clay from all pumping in 2000 was approximately 0.002 foot at the Fordel extensometer and 0.014 foot at the Yearout Ranch extensometer (LSCE and KDSA 2001). The amount of subsidence attributed to MPG transfer pumping at the Yearout Ranch extensometer in 2000 was 0.0045 foot. Subsidence was greater at both locations in 2001, partly because MPG deep zone pumping was larger. Total subsidence above the Corcoran Clay in 2001 was approximately 0.003 foot at the Fordel extensometer and 0.021 foot at the Yearout extensometer. The amount of subsidence at the Yearout Ranch extensometer attributed to MPG transfer pumping in 2001 was about 0.01 foot.

3.4.4.2 Westlands Water District

Prior to the delivery of CVP water to WWD, the annual groundwater pumpage ranged from 800,000 to 1,000,000 acre-feet during the 1950-1968 period. Because most wells in WWD are screened below the Corcoran Clay, the majority of this pumpage was from the lower aquifer, causing the sub-Corcoran piezometric groundwater surface to reach the lowest recorded average elevation of more than 150 feet below mean sea level by 1968. The large quantity of groundwater pumped prior to delivery of CVP water caused compaction in the Corcoran Clay and other fine-grained sediments, resulting in land subsidence which ranged from 1 to 24 feet between 1926 and 1970 (U.S. Geological Survey 1988, as cited in WWD 1999).

Beginning in 1968, surface water deliveries from the CVP largely replaced groundwater for irrigation. However, extensive pumping occurred in 1977, a drought year during which only 25 percent of WWD's entitlement of CVP water was delivered. In response to the surface water shortfall, farmers reactivated old wells and constructed new wells, pumping nearly 500,000 acre-feet of groundwater to irrigate their crops. The piezometric surface declined about 90 feet, resulting in localized subsidence of about 4 inches according to USGS officials. Since 1990, the volume of groundwater pumped by WWD farmers has varied from 15,000 acre-feet in 1998 to 600,000 acre-feet in both 1991 and 1992. In six of the 11 years from 1990 to 2000 (the most recent year for which data are available), at least 150,000 acre-feet per year of groundwater were pumped in WWD for irrigation.

3.4.5 GROUNDWATER QUALITY

Groundwater was sampled periodically during 1999, 2000, 2001, and 2002 at MPG wells (Terra Linda, Fordel, Conejo West, Coelho/Coelho, Coelho/Coelho/Fordel, Silver Creek, Meyers, Five Star, FWD, Baker, and Panoche Creek) and municipal, monitoring, and non-MPG irrigation wells (USGS, Hansen Farms, City of Mendota, Locke Ranch, NLF, Spreckels Sugar Co., and CCID) as part of the monitoring program conducted by the MPG, the SJREC, and NLF (KDSA and LSCE 2000a,b, and LSCE and KDSA 2001, 2002). Data for Meyers Farming monitoring well P-6 are not included in this evaluation because this well is impacted by tile drainage from an adjacent field, and the constituent levels are anomalous as compared to nearby wells. Well P-6 is no longer included in the monitoring program. Groundwater quality data for parameters of interest are tabulated separately for the shallow (above the A-clay) and deep (below the A-clay) zones of the upper aquifer near the Mendota Pool in Tables 3-7 and 3-8, respectively. The most recent data available are included for each well for water quality parameters of particular interest: arsenic, boron, selenium, molybdenum, and salinity (measured as EC or TDS). Historical data for all constituents and dates are provided in Appendix C. The wells are sorted according to geographic region (San Joaquin River Arm, Northern Fresno Slough, and Central Fresno Slough, Southern Fresno

Slough, North of Mendota, West or East of the Fresno Slough, and North of the San Joaquin River), as described in Section 3.3.1.5.

3.4.5.1 Arsenic

Arsenic was detected in 9 of 55 shallow and 6 of 39 deep production or monitoring wells tested in groundwater monitoring programs in the Mendota Pool area (Tables 3-7 and 3-8). Detected concentrations were generally at, or just above, the detection limit of 2 µg/L. Most of the detected concentrations in the shallow wells were along the Northern Fresno Slough, where the highest detected concentration was 4 µg/L. Arsenic was detected at 3 µg/L in one deep MPG production well in FWD. It was also detected in the three new City of Mendota wells along the San Joaquin River arm of the Pool at concentrations up to 5.8 µg/L. The only other area where arsenic was detected in deep wells was west of Fresno Slough, where it was detected in two wells at concentrations of 5 µg/L or less.

The lowest water quality criteria target levels for arsenic are 5 µg/L for Refuge Surface Water Quality and 10 µg/L for protection of aquatic life (Table 3-4). Arsenic was not detected in any MPG production well in the most recent monitoring event at a level exceeding the Refuge Surface Water Quality target level.

3.4.5.2 Boron

Boron was detected in all wells tested. Concentrations in shallow wells ranged from 0.21 to 7.70 mg/L. The highest detected boron concentration occurred in a very shallow monitoring well west of the Fresno Slough. None of the 13 shallow MPG wells along the northern Fresno Slough had boron concentrations exceeding 0.6 mg/L; the average boron concentration was 0.33 mg/L. Of the 26 shallow wells along the Central Fresno Slough, 14 exceeded 0.6 mg/L boron in the most recent testing. Shallow wells in the Southern Fresno Slough had boron concentrations ranging from 0.31 to 1.20 mg/L, with an average of 0.62 mg/L. Again, the highest boron concentrations in this area were detected in non-production wells. The shallow and deep NLF monitoring wells north of the San Joaquin River had boron concentrations ranging from 0.15 to 0.28 mg/L. Boron in non-production wells east of Fresno Slough ranged from non-detect (<0.1) to 1.30 mg/L, and the shallow USGS wells west of Fresno Slough had 1.43 and 4.10 mg/L boron.

Deep wells had boron concentrations ranging from 0.05 to 4.98 mg/L overall. Boron in wells north of the San Joaquin River ranged from 0.04 to 0.60 mg/L, and averaged 0.23 mg/L. In deep wells along the San Joaquin River arm of the Pool, the highest boron concentration was 0.61 mg/L, with an average concentration of 0.22 mg/L in the 15 wells tested. In the northern Fresno Slough region, the maximum boron concentration detected in deep wells was 0.70 mg/L, and the average boron concentration of the seven wells tested in this region was 0.52 mg/L. Boron concentrations in deep wells in the central Fresno Slough region ranged from 0.55 to 1.11 mg/L, with an average of 0.81 for the four wells tested. There are no deep wells included in the monitoring programs in the southern Fresno Slough area.

In general, boron concentrations are higher in deep wells located away from the Pool. In deep wells north of the City of Mendota, boron ranged from 0.10 to 1.40 mg/L. Concentrations in wells (non-pumping) east and west of Fresno Slough ranged from 0.44 to 4.98 mg/L, with the highest concentrations present in the upgradient wells to the west (USGS well 10A4 and Hansen Farms well 7C1).

The lowest water quality criterion for boron is the target level of 0.3 mg/L for Refuge Surface Water Supply (Table 3-4). The severe or unacceptable value for Refuge Surface Water Supply is 0.6 mg/L. Average boron concentrations for shallow wells were less than 0.6 mg/L in the northern Fresno Slough and north of the San Joaquin River areas, but greater than 0.6 mg/L in other areas. Deep wells averaged less than 0.6 mg/L in all but the central Fresno Slough and west of Fresno Slough regions.

3.4.5.3 Molybdenum

The most recent molybdenum concentrations measured in shallow wells ranged from 1.6 to 58.4 μg/L. The lowest average molybdenum concentration was in the northern Fresno Slough shallow wells, while the highest concentration was observed in a shallow monitoring well west of the Fresno Slough. Molybdenum concentrations in deep wells ranged from 1.8 to 37 μg/L. Average molybdenum concentrations in the various regions ranged from 5.5 (San Joaquin River Arm) to 21.9 μg/L (west of Fresno Slough). No molybdenum data were available for wells north or west of the San Joaquin River.

The lowest water quality criteria for molybdenum are the target levels of 10 μg/L for both Refuge Surface Water Supply and aquatic life protection (Table 3-4). Only two of the 23 deep production wells had molybdenum concentrations greater than 10 μg/L. However, 30 of 44 shallow production wells exceeded 10 μg/L molybdenum. The majority of these shallow wells are located in the central and southern Fresno Slough regions. Many of these wells also have high TDS levels and will not be included in the MPG pumping program, or pumping from these wells will be limited.

3.4.5.4 Selenium

As noted in Section 3.3.2.4, data quality issues have been identified regarding the accuracy of many of the historical selenium analyses and analyses conducted by other monitoring programs. Results of a interlaboratory comparison program conducted in 2001 indicated that data quality objectives were probably not met for selenium results reported by laboratories other than Reclamation, Olson Biochemistry Laboratories (OBL), and Frontier Geosciences.

Review of recent selenium data of acceptable quality for groundwater indicate that selenium is not present above the detection limit of 0.4 μg/L in most wells in the Mendota Pool area. Selenium was detected in four shallow wells, and all concentrations were less than 1.0 μg/L. Selenium was detected in three deep wells, and the only well that exceeded 1.0 μg/L was the unused Hansen Farms well 7C1 (65.6 μg/L).

The lowest water quality criteria for selenium are the target levels of 2 μg/L for both Refuge Surface Water Supply and aquatic life protection (Table 3-4). All production wells with data of adequate quality have selenium concentrations well below these criteria.

3.4.5.5 Salinity (as TDS)

Groundwater quality in the project vicinity is highly variable. Patterns evident in the data were consistent with regional and local patterns described by previous investigators. Previous studies (Woodward Clyde Consultants 1994, cited in Jones and Stokes 1995) indicated that there was a local pattern in groundwater quality. Groundwater in wells away from the San Joaquin River and the Mendota Pool were, on average, about twice as saline as groundwater near the Mendota Pool, which was in turn about twice as saline as groundwater near the River (mean TDS concentrations of 1,756 mg/L, 777 mg/L, and 294 mg/L, respectively) (Jones and Stokes 1995). Among the MPG wells along the Fresno Slough, groundwater in the southern half of the well field (central Fresno Slough) was more saline than groundwater in the northern half of the well field (northern Fresno Slough). The composition of shallow groundwater near the Mendota Pool was chemically and isotopically intermediate between that of regional groundwater and groundwater near the River. This pattern indicates that the shallow groundwater quality benefits from recharge of surface water from the River and the Mendota Pool (Jones and Stokes 1995).

Salinity of Shallow Groundwater

Shallow wells located along the northern portion of the Fresno Slough generally have lower salinity than shallow wells located further south. TDS concentrations in the shallow wells located in the northern Fresno Slough region (Fordel and Terra Linda) ranged between 390 and 870 mg/L in the most recent samples, with an average of 593 mg/L (Table 3-7). Shallow wells in the central Fresno Slough region had TDS concentrations from 460 to 6,000 mg/L. Four monitoring wells at Meyers Farming had very high TDS, which contributed to an average concentration of 2,139 mg/L TDS for the central Fresno Slough region. In the southern Fresno Slough region, TDS concentrations were generally higher, ranging from 680 to 6,200 mg/L, with the highest concentrations occurring in the shallow Meyers Farming monitoring wells. The average TDS (1,879 mg/L) was slightly lower than the central Fresno Slough.

West of the Fresno Slough, TDS was measured in shallow upgradient USGS wells at concentrations of 3,490 and 5,750 mg/L.

TDS in shallow monitoring wells east of Fresno Slough (Meyers Farming and Spreckels Sugar Co.) ranged from 220 to 4,100 mg/L, with an average of 1,571 mg/L. The higher TDS concentrations at Spreckels Sugar Co. are the result of groundwater degradation due to wastewater from the Spreckels Sugar Co. factory. Historically, this wastewater percolated from ponds west of the plant site and is currently used to irrigate permanent pasture on the Spreckels' property.

The SAR was calculated, as data were available, for the groundwater samples shown in Table 3-7. SAR values varied widely between wells and regionally, following a similar pattern to TDS. The SAR in northern Fresno Slough shallow wells ranged from 2.1 to 6.4, with an average of 3.8. The SAR in the central Slough shallow wells ranged from 3.5 to 25.3, with an average of 11.9, and the southern Slough SAR ranged from 4.4 to 26.9, averaging 11.4. SAR values for shallow NLF monitoring wells north of the San Joaquin River ranged from 3.1 to

13.0. SAR values in shallow monitoring wells east and west of the Fresno Slough varied significantly, ranging from 0.6 to 67.7. The two extreme values of the SAR range both occurred east of the Fresno Slough at Spreckels Sugar Co. monitoring wells. The higher value reflects shallow groundwater degraded due to wastewater, whereas the lower value is indicative of background water quality unaffected by wastewater.

When evaluated together with the EC, the SAR values in almost all of the shallow wells indicate either no impairment or slight to moderate impairment for irrigation purposes. The SAR of two of the wells (Coelho West wells CW-4 and CW-5) indicate severe impairment. The elevated SAR values in these wells may be an indication that these northernmost wells in the Coelho West cluster are affected by Spreckels' wastewater. The highest SAR value for any of the shallow wells included in the monitoring program was reported at Spreckels Sugar Co. well MW-1 (67.7). The lowest SAR in any shallow monitoring well was 0.6 in Spreckels Sugar Co. well MW-30.

Salinity of Deep Groundwater

Deep wells along the San Joaquin River arm of the Mendota Pool had TDS concentrations ranging from 150 to 520 mg/L, with an average of 362 mg/L. TDS in deep wells north of the San Joaquin River showed similar salinity, ranging from 173 to 608 mg/L, with an average of 356 mg/L. The TDS concentrations in wells located further south near Spreckels Sugar Co. were higher than in wells near the River.

The pattern of water quality in deep wells along the Fresno Slough is similar to that in the shallow wells, with salinity generally lower in northern Fresno Slough wells than in central Fresno Slough wells (Table 3-8). In wells along the northern Fresno Slough, TDS ranged between 450 and 1,040 mg/L, with an average of 787 mg/L (data for 7 of 8 wells). TDS in deep wells along the central Fresno Slough ranged from 900 to 2,140 mg/L and averaged 1,623 mg/L (data for 4 of 5 wells). There are no deep wells along the southern Fresno Slough.

Deep wells west of the San Joaquin River ranged from 340 to 1,600 mg/L TDS, and average 816 mg/L, while wells to the south (west of Fresno Slough) range from 350 to 7,100 mg/L and average 2,728 mg/L. The upgradient Hansen Farms and USGS wells are included in this area and have TDS concentrations ranging from 2,370 to 7,100 mg/L. TDS concentrations in deep monitoring wells at Spreckels Sugar Company east of the Fresno Slough ranged between 740 and 4,500 mg/L. Because the water quality in some of these wells has been affected by deep percolation of wastewater, these concentrations are not representative of the deep groundwater quality in all areas of Spreckels Sugar Company.

SAR values in deep wells along the northern Fresno Slough ranged from 15.6 to 25.5, and along the central Slough, SAR ranged from 22.0 to 29.4. Based on the SAR, all of the deep MPG wells would be classified as either slight to moderate or severe in terms of impairment for irrigation purposes, using the classification system in Ayers and Westcot (1985). In non-MPG deep wells, the SAR of wells sampled in 2001 ranged from 2.2 in City of Mendota well No. 6 (1/23/96, most recent data available) to 26.4 in Spreckels Sugar Co. well MW-15 (6/06/01) (Table 3-8).

Water Quality Criteria for Salinity (as TDS)

The lowest water quality criterion for TDS is a target level of 400 mg/L (as a 5-year average) for Refuge Surface Water Supply (Table 3-4). The 1-year average target level is 450 mg/L, and the monthly average is 600 mg/L. Many MPG production wells have TDS concentrations exceeding 600 mg/L, especially in the southern Fresno Slough region. However, salinity contributions from these wells will not cause salinity in the southern Fresno Slough to exceed average water quality criteria for Refuge Surface Water Supply, due to adaptive management of pumping programs, which limits the amount of groundwater pumped from wells with high TDS levels into the Slough.

3.5 SEDIMENT

A sediment quality monitoring program in the Mendota Pool was implemented in August 2001. The objectives of the sediment monitoring program are to provide baseline characterization of metal concentrations in Mendota Pool sediments and to allow for future identification of temporal and spatial trends in sediment quality.

The monitoring program was designed to allow assessment of spatial distribution of selected parameters (EC, arsenic, boron, molybdenum, and selenium) in the sediment. The sampling locations include areas that are not likely to be influenced by MPG pumping as well as areas that could receive inputs of metals from MPG water (Figure 3-11) and are co-located with surface water sampling stations. The station locations allow estimation of metals inputs from the San Joaquin River, the DMC, and the James Bypass.

Data are available for the first three rounds of sampling: August 22, 2001, October 30, 2001, and October 16, 2002. During each sampling event, samples were collected in triplicate from eight stations in the Mendota Pool:

1. Near the Columbia Canal intake (COL).
2. At Mendota Dam (MED).
3. At the DMC outlet (DMC).
4. At the Firebaugh Intake Canal intake (FIC).
5. At the Etchegoinberry introduction point (EGB).
6. At the MWA approximately ¼ mile south of Whites Bridge Road (WBR).
7. At the James Irrigation District Booster Plant (JID).
8. In Lateral 6 (LAT).

The samples were analyzed for selenium, arsenic, boron, molybdenum, grain size (percent sand, silt, and clay), percent moisture, cation exchange capacity (CEC), EC, total organic carbon (TOC), and pH. The latter four parameters were analyzed to allow evaluation of the ability of the sediment to bind metals. The results of the sediment sampling program for 2001 and 2002 are provided in Table 3-9 and are categorized according to the same geographic regions as the surface water stations and groundwater wells. In general, concentrations of the metals and EC showed variability between replicates within each sampling station.

In the August 2001 sampling event, EC and arsenic were reported in all 24 samples. Boron was detected in 14 samples, and molybdenum was detected twice. The sample-specific detection limit for molybdenum ranged from 0.81 mg/kg (dry weight) to 2.1 mg/kg (dry weight).

Selenium was not detected in any of the samples in the August 2001 sampling event, but the sample-specific detection limits for selenium were high due to analytical interferences with aluminum. One sample from each station was subsequently reanalyzed by Frontier Geosciences using a more sensitive analytical technique that has lower detection limits and does not have interference from aluminum. Results from the reanalysis yielded concentrations ranging from 0.10 mg/kg (dry weight) to 2.94 mg/kg (dry weight). The selenium concentration at the Columbia Canal in the San Joaquin River arm of the Mendota Pool was 0.70 mg/kg (dry weight). The maximum reported concentration was in a sample collected near the mouth of the DMC in the central Mendota Pool region. Concentrations in samples collected at Mendota Dam and at the Firebaugh Intake Canal in this region were intermediate (0.72 and 0.86 mg/kg dry weight). The second highest concentration (1.58 mg/kg dry weight) was detected at Etchegoinberry, in the central Fresno Slough region. The lowest selenium concentrations were measured at the three stations in the southern Fresno Slough surrounding the Mendota Wildlife Area.

Samples collected in October 2001 were analyzed by Columbia Analytical Services in Kelso, Washington. Results from the October 2001 event are generally similar in magnitude and pattern to those from the August 2001 event. However, the reported concentrations of metals and EC were slightly lower than in August and appear to be less variable. Reported values for TOC and CEC were slightly higher than in the August event.

Arsenic and boron were detected in all of the October 2001 samples. However, 6 of the 24 boron results were between the method detection limit and the reporting limit. Arsenic ranged from 2.3 mg/kg to 10.9 mg/kg (dry weight). Boron ranged from 5.05 to 40 mg/kg (dry weight). Only 10 of the 24 samples contained molybdenum at concentrations greater than the detection limit of 0.8 mg/kg (dry weight). None of the 10 samples contained molybdenum exceeding 1.8 mg/kg (dry weight). Selenium was not detected in any of the sediment samples, with detection limits ranging from 0.9 mg/kg to 1.2 mg/kg (dry weight).

Few sediment quality guidelines are available with which to evaluate sediment quality. For the parameters of concern in this analysis, guidelines are only available for arsenic and selenium (Table 3-4). The effects range-low (ER-L) value for arsenic identified by U.S. EPA (1996) is 12.1 mg (arsenic)/kg (dry weight). None of the detected arsenic concentrations exceeded this screening value. The highest concentrations occurred in the central Mendota Pool and the northern Fresno Slough region, extending as far south as Etchegoinberry.

Screening criteria for selenium have been developed by USFWS for the Grasslands Watershed (Reclamation 2000), which is located immediately north of the Mendota Pool. The screening criteria for selenium include a target level of 2 mg/kg, and a toxicity threshold of 4 mg/kg (dry weight). The detection limits for selenium in the August 2001 samples were elevated and variable. However, of the eight reanalyzed August 2001 samples, only one exceeded the target level. In the October 2001 samples, selenium concentrations were all less than the maximum detection limit of 1.2 mg/kg (dry weight); none exceeded the target level of 2 mg/kg.

The influence of MPG pumping can also be assessed by examining the spatial distribution of parameters of interest in the sediment. If MPG pumping was introducing metals and salts into the sediment, it would be expected that the sediments in the vicinity of the MPG wells would exhibit higher concentrations than those observed in sediments from other areas of the Pool.

The sediment quality data from the October 2001 sampling event are statistically analyzed to determine whether they could be associated with MPG pumping. Due to the limited number of detected values for molybdenum, and selenium only arsenic, boron, and EC could be statistically analyzed using analysis of variance (ANOVA), followed by the Least Significant Difference (LSD) test (Sokal and Rohlf 1981). Due to the variability in the analytical data, the data were natural-log transformed prior to analysis. Significant differences were identified between sampling stations for arsenic, boron, and EC in the ANOVA. The results of the LSD tests are displayed in Figure 3-12; stations that are linked by a single line are considered to be not significantly different from each other.

Mean arsenic concentrations were lowest at the James Irrigation District Booster Plant station, and at the Columbia Canal and Lateral 6 stations. Highest arsenic concentrations were found at the Delta Mendota Canal and Mendota Dam stations. Exceedances of applicable sediment quality guidelines (Table 3-4) occur primarily in samples from the northern portion of the Pool. Average arsenic concentrations tend to decrease towards the southern portion of the Pool. The limited spatial data suggest that the MPG wells are not contributing to increased arsenic concentrations in the Fresno Slough. In addition, arsenic was generally not detected, or was detected at very low concentrations, in the groundwater samples from the MPG production wells (Table 3-7 and 3-8). These data indicate that the MPG wells do not influence the arsenic concentrations in the sediments.

Boron was highest in sediment samples from the Delta-Mendota Canal, Whites Bridge Road, and Lateral 6 stations. Lowest concentrations were observed at the Columbia Canal and James Irrigation District Booster Plant stations.

The highest EC concentrations were detected at the Delta-Mendota Canal and Lateral 6 stations, whereas the lowest concentrations were found at the Columbia Canal, Etchegoinberry, and Whitesbridge Road stations. The limited data show no indication that the spatial distribution of salinity in the sediment samples is associated with inflow from the MPG wells.

Sediments in the San Joaquin River arm of the Pool (i.e., Columbia Canal station) appear to consistently have the lowest metals and salt concentrations. Sediment conditions at samples in the southern Pool vary depending on which analyte is being considered and on the date of the sampling event.

3.6 REGIONAL MONITORING PROGRAMS

Several monitoring programs are currently occurring in the project vicinity. These monitoring programs are being undertaken by Reclamation, CVRWQCB, USGS, CDFG, SLDMWA, and WWD. A brief summary of these monitoring programs is provided in this section.

3.6.1 U.S. BUREAU OF RECLAMATION

Reclamation currently has three ongoing monitoring programs along the DMC: sump monitoring, Warren Act pump-ins, and continuous selenium monitoring (Field 2002).

3.6.1.1 Sump Monitoring

Reclamation has been monitoring a series of six sumps located between Russel Avenue at mile point (MP) 97.68 and Washoe Avenue at MP 110.12. This program has been ongoing since 1986. Monitoring frequencies and parameters measured have changed over time. Since 1998, the sumps have been sampled twice yearly for metals, common cations, and common anions. Selenium and EC are measured weekly in all six sumps.

3.6.1.2 Warren Act Pump-Ins

Reclamation is required to monitor water quality in wells that discharge directly into the DMC. Each well is sampled prior to entry into the program, and subsequently every three years. Parameters measured include Title 22 metals and pesticides.

3.6.1.3 Continuous Selenium Monitoring

A continuous selenium monitoring program was initiated in July 2002 at the request of the USFWS. Daily composite samples for selenium, boron, and TDS are collected using an autosampler at three locations along the DMC: at the headworks (MP 3.5), Check 13 (O'Neill Forebay), and at Bass Avenue (DMC terminus). Monthly composite samples are collected for molybdenum at these same locations.

3.6.1.4 Drinking Water Quality

A fourth program was initiated in November 2002 at the request of the California Department of Health Services (DHS). This program collects biweekly samples from the DMC between the headworks and Check 13. The samples are analyzed for alkalinity, total organic carbon (TOC), and coliforms.

3.6.2 CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD

The focus of the CVRWQCB monitoring efforts is on the San Joaquin River below the confluence of Bear Creek (Lander Avenue), and consists of two major programs that are relevant to the Proposed Action: the Selenium Control Program and the Surface Water Ambient Monitoring Program (SWAMP). The CVRWQCB also participates in the Grasslands Watershed monitoring program. The CVRWQCB is also conducting monitoring for organophosphate pesticides, nutrients, and mercury within the San Joaquin River Basin. These programs are implemented through cooperative arrangements between CVRWQCB, USGS, USFWS, the Department of Pesticide Registration, and U.C. Davis. The CVRWQCB compiles data for a total of 62 stations within the San Joaquin River system. The Selenium Control Program, SWAMP, and Grasslands Watershed programs are described below.

3.6.2.1 Selenium Control Program

This program was initiated in 1985. The program involves collection of weekly samples for selenium, boron, and electrical conductivity at 14 stations on the San Joaquin River and in the Grasslands Watershed. The purpose of this monitoring program is to assess impacts to the Grasslands Watershed. At the majority of stations, flow is reported on a daily basis; other parameters are sampled weekly. However, at certain locations, EC is reported on a daily basis. Furthermore, at other stations (e.g., CCID, and the San Joaquin River at Crows Landing) the measurements are only conducted during the irrigation season (May through September). A summary of the available data from 1985 through 1995 is available at the State Water Resources Control Board website

(http://www.swrcb.ca.gov/rwqcb5/programs/agunit/load/10yrload.htm).

3.6.2.2 Surface Water Ambient Monitoring Program (SWAMP)

The SWAMP was initiated in 2000, as a cooperative project between the CVRWQCB, USGS, Reclamation, and the University of California at Davis. The program samples between 50 to 60 sites along tributaries to the San Joaquin River between South Dos Palos and Lodi.

3.6.2.3 Grassland Watershed Program

The Grasslands Watershed monitoring program was initiated in May 1985 to evaluate the effects of subsurface agricultural drainage on surface water quality in the Grasslands Watershed (Crader 2002). The study area is located on the western side of the San Joaquin River, between Mendota and Newman. The original program was modified in 1997 to reflect changes in the drainage patterns within the study area. Current sampling efforts are conducted at ten sites including inflow, internal flow, and outflow locations. Inflow sampling sites include the CCID Main Canal at Russell Blvd., the Agatha Canal at Mallard Road, and Camp 13 Slough. Grab samples for EC, selenium, and boron are collected at all sites on a weekly basis. Additional parameters including temperature, pH, molybdenum, trace elements, minerals, and TSS are collected at intervals varying from weekly to quarterly at four locations. Automated samplers collect daily composite samples for EC, and weekly composites for boron and selenium. The automated samplers are located at the inflow and outflow of the San Luis Drain.

3.6.3 WESTLANDS WATER DISTRICT

WWD conducts annual monitoring of water levels and groundwater quality (EC) in water users wells. Currently, there are approximately 750 groundwater wells in WWD. Groundwater levels are monitored in the winter to determine static elevations. EC is measured during periods of high groundwater pumpage (i.e., summer) (WWD 1996).

3.6.4 TRANQUILITY IRRIGATION DISTRICT

Tranquility ID participates in the MPG surface water monitoring program at the Lateral 6 sampling station (Green 2002). In addition, Tranquility ID measures water levels and TDS in five deep wells (250 feet deep) and several shallow wells during the spring and fall. Occasionally, these wells will also be monitored for general minerals. The California Department of Health Services monitors two sub-Corcoran Clay drinking water wells within Tranquility ID.

3.6.5 JAMES IRRIGATION DISTRICT

James ID is the furthest south of the irrigation districts that obtain water from the Mendota Pool. A continuous EC recorder at the James ID booster plant monitors EC and temperature (Mallyon 2002). This location is also a grab sampling location for the MPG monitoring program. James ID also conducts annual groundwater monitoring on a network of 58 deep wells for groundwater levels and EC. Wells are only monitored when they are actively pumping. Approximately 15 to 20 years of data have been compiled by James ID.

3.7 BIOLOGICAL RESOURCES

Although the project area is highly agricultural, several areas in the project vicinity could support plants and wildlife species. These areas include the Mendota Wildlife Area, the Mendota Pool, and fallowed or idled agricultural lands.

California Department of Fish and Game has suggested that the project could affect special-status species and their habitats through plowing of fallowed agricultural fields that may have been recolonized, and through regional land subsidence. CDFG refuge managers also expressed concerns about the possible adverse effects on the MWA and wetland habitats near Mendota Pool and elsewhere along Fresno Slough. The USFWS has expressed concerns about the possible effects of reduced surface water and sediment quality on the giant garter snake (J. Winkle, USFWS, pers. comm. 2001).

3.7.1 MENDOTA WILDLIFE AREA

The 12,425-acre MWA is the largest publicly owned and managed wetland in the San Joaquin Valley. The refuge is bisected by the Fresno Slough and is adjacent to the 900-acre Alkali Sink Ecological Reserve (Figure 1-3).

Approximately 8,300 acres of wetlands are maintained on the refuge, including almost 6,800 acres of seasonal wetlands. Surface waters near this refuge may or may not support wetland or riparian habitat depending on the type of channel (i.e., lined or unlined), maintenance activities, hydrologic conditions, and adjacent land use activities (Jones and Stokes 1995). Vegetation at the MWA is primarily managed to encourage production of native plants that provide food for waterfowl.

Originally, the vegetation near Fresno Slough was predominantly tule marsh and alkali sink scrub (Jones and Stokes 1995). Today, much of this vegetation has been eliminated by conversion to agriculture, but tule marsh persists around the margins of Fresno Slough and fragments of alkali sink scrub remain at the Alkali Sink Ecological Reserve. Other native communities at MWA are valley sink scrub, valley sacaton grasslands, and heavily grazed scalds and vernal pools.

The MWA supports approximately 10 to 20 million waterfowl use-days per year, as well as a wide variety of non-game species (Huddleston, 2002). Waterfowl populations fluctuate from year to year and from month to month. Table 3-10 presents an estimate of average waterfowl use-days. During the winter and spring, thousands of shorebirds, white-faced ibis, cattle egret, greater egret, snowy egret, great blue heron, and long-bill curlews frequent the MWA and nest. These species are not reflected in this estimate.

3.7.1.1 Special-Status Species

Several special-status wildlife species have been recorded at MWA: giant garter snakes, white-faced ibis, Swainson’s hawks, and tricolored blackbirds. Fresno kangaroo rats have been recorded at the adjacent Alkali Sink Ecological Reserve. Palmate-bracted bird’s-beak is a special-status plant that has been recorded at MWA and also occurs at the Alkali Sink Ecological Reserve, along with the rare plants heartscale and Hoover’s eriastrum.

3.7.1.2 Water Source and Quality

Seasonal wetlands and grain crops are irrigated with CVP water delivered via the Mendota Pool. WWD facilities, including Laterals 4 and 6, provide water to MWA for domestic use. Groundwater is not used for irrigation at the MWA. All wells at MWA have been sealed because of excess boron in groundwater (Jones and Stokes 1995). In general, water use at the refuge varies seasonally, with most water diversions occurring during the fall to fill ponds for migrating waterfowl. An average of 16,553 acre-feet/year of water was delivered to the refuge during 1997-2000. The MWA contracted for 27,584 acre-feet for the 2001 water year. Of this, 12,757 acre-feet are scheduled for delivery between September and November 2001 (Loudermilk, 2001). Water from the MWA is returned to the Mendota Pool in the spring (March-April) for reuse (R. Huddleston 2001, pers. comm.).

3.7.2 MENDOTA POOL

The Mendota Pool is formed by a dam that is owned, operated, and maintained by CCID. The dam backs up water in the Fresno Slough to the James Bypass and in the San Joaquin River almost to San Mateo Avenue. The Mendota Pool is surrounded by areas of intensive agriculture and consequently has limited wildlife habitat value. The margins of the Mendota Pool support some areas of emergent vegetation dominated by cattails and tules; a few cottonwoods and willows grow above the water line. Open water habitat may attract migratory ducks such as mallards, gadwalls, and ruddy ducks. Emergent vegetation provides limited habitat for marsh-dwelling species such as rails, herons, and various songbirds.

Most of the Mendota Pool is less than 10 feet deep, with the deepest areas no more than 20 feet deep. Inflows and outflows from the Mendota Pool are balanced so that the Mendota Pool remains at a relatively constant depth. The Mendota Pool must remain above 14.5 feet at the Mendota Dam gage for users in the southern portion of the Mendota Pool (e.g., the MWA) to be able to draw water (R. Huddleston 2001, pers. comm.). However, the Mendota Pool is drained regularly by CCID to allow dam maintenance and repair activities to be carried out, as occurred between November 1999 and January 2000 and again in November 2001. These abrupt changes in water level reduce the overall fish and wildlife habitat values of the Mendota Pool.

The Mendota Pool was drained in late November 2001 to allow the dam to be inspected. Isolated areas of ponded water remained in low lying portions of the Pool. A team of two fisheries biologists visited the Pool on December 6, 2001 to conduct a qualitative survey of fish species presence and relative abundances (Table 3-11). Sampling was attempted at five locations using duplicate hauls of a 50-foot seine net. A summary of site conditions is provided below.

Mendota Dam/Outside Canal intake/Main Canal intake

This area could not be sampled due to unstable condition of the in-channel substrate. The in-channel substrate was dominated with silt/mud and a small component of sand. Low-water banks along the pools were approximately 8 feet, and were comprised of mainly mud/silt. No vegetation was found in-channel or on low-water banks. Streamflow was intermittent with pockets of standing water that formed pools of various depths. Water was being diverted into the Main Canal to allow biannual inspection of the Mendota Dam.

Columbia Canal intake confluence with the San Joaquin River (CC)

The San Joaquin River was sampled at the mouth of the Columbia Canal intake. In-channel substrate was very stable and consisted of clay-mud and mix of sand and cobble near armored banks. Emergent vegetation (*Ludwigia* sp.) was growing 5 feet from the edge of bank and small patches of aquatic vegetation (*Elodea* sp. and *Myriophyllum* sp.) were found in-channel.

Firebaugh Canal intake

Water depth adjacent to the intake was too shallow to sample. No fish were visually observed near intake structure. A snowy egret was observed fishing in a small flowing channel approximately 500 feet from the intake. No vegetation was found in-channel or near the low-water banks.

Delta Mendota Canal outlet (DMC)

The southern bank (opposite of the boat dock) of the canal was sampled approximately 500' downstream of its outlet. The in-channel substrate consisted of a stable hard clay/mud bottom near the outlet and became unstable mud/silt towards the Pool. Little or no aquatic of emergent vegetation was found at the sampling location.

Fresno Slough upstream of White's Bridge (WBR)

The southern Fresno Slough was sampled approximately 1000 feet upstream of the White's Bridge on the eastern bank. The water level had receded 25 feet from the average water level as a result of draining the Pool. The in-channel substrate was dominated by sand/mud with a fine amount of silt. Emergent vegetation was found growing near the edge of bank. Sparse emergent vegetation (*Scirpus* sp.) was found near the low-water bank. Aquatic vegetation was sparse.

The fish community in the Pool was dominated by a mix of introduced and native species (Table 3-11). Dominant species in the catch included threadfin shad, bluegill, inland silverside, and redear sunfish.

3.7.2.2 Special-Status Species

Several special-status wildlife species have been recorded near the Mendota Pool including giant garter snakes, Swainson's hawks, yellow-billed cuckoos, and bank swallows (Jones and Stokes 1995). Swainson's hawks may be the only special-status wildlife species remaining near the Mendota Pool. Yellow-billed cuckoos have not been sighted there since the 1950s, and giant garter snakes and bank swallow have not been detected since 1976 and 1980, respectively (Jones and Stokes 1995). Sanford's arrowhead is apparently the only special-status plant species that has been recorded near the Mendota Pool (Jones and Stokes 1995).

3.7.3 Fallow Agricultural Lands

A variety of row, orchard, and vine crops are produced in WWD, and the proportions represented by different crops vary each year. Similarly, the amount of fallow land varies annually, and may range from 16,340 acres (as in 1984) to 125,082 acres (as in 1991). Fallow lands are temporarily removed from production and are a normal part of agricultural processes in the San Joaquin Valley. In contrast, idle lands are areas that are removed from production for extended periods and generally remain unmanaged (i.e., unplowed). Very little arable land in WWD remains idle (J. Bryner 2001, pers. comm.). Idle lands near known special-status populations have a higher probability of being recolonized with endangered species than fallow lands that are part of normal farm operations.

While it is true that land idled near native habitat may become occupied by threatened or endangered species, it is also true that land is idled or fallowed and subsequently brought back into agricultural production for reasons not related to this action. Extended drought, lowered prices for commodities, and increased power costs, plus routine rotation of crops are all causes for lands to be fallowed or idled, and later planted. Fallowed land is routinely disced for weed control, and idled land is usually brought back into production in years when water is abundant.

3.7.3.1 Special-Status Species

Because of the large size of the WWD, numerous special-status wildlife species have been observed within its boundaries, including Swainson's hawks, prairie falcons, burrowing owls, San Joaquin antelope squirrels, San Joaquin pocket mice, giant Kangaroo rats, Fresno kangaroo rats, Tipton kangaroo rats, San Joaquin kit foxes, and blunt-nosed leopard lizards (Jones and Stokes 1995). Many of these sightings were made in remnant habitat areas along levees and along the margins of roads and fields. Some of these species, including many of the rodents, were originally present in the area but have been largely eliminated from their former habitat areas. Special-status plants that have been recorded in the WWD are Lost Hills crownscale and San Joaquin woolythreads.

3.7.4 ENDANGERED AND THREATENED SPECIES

A list of Federal and State threatened, endangered, proposed listed, candidate, rare, species of concern, and/or species of special concern that may occur in the study area was requested from the USFWS, on August 29, 2001. On October 24, 2001, the USFWS provided a list of protected species in the eleven 7.5-minute USGS quadrangles surrounding the project vicinity. Also, a list of state endangered, threatened, proposed listed, candidate, rare, and species of special concern was obtained from a query of the California Natural Diversity Database (CNDDB). In addition, a letter from W. Loudermilk, Regional Manager San Joaquin Valley and Southern Sierra Region CDFG, dated July 13, 2001, identified protected species in the project vicinity.

Table 3-12 lists species that CDFG identified as special status species in the study area (Loudermilk 2001). The table lists the species name, listing, the most recent sighting recorded within the project area according to the CNDD, habitat requirements for the species, site use, and when breeding occurs. The listing status of each species is coded S = State, F = Federal, E = Endangered, T =Threatened and C = Concern. The USGS quads used to run the CNDDB include Mendota, Tranquillity, Firebaugh, Poso Farm Oxalis, Dos Palos, Charleston School, Coit Ranch, Jamesan, San Joaquin, and Helm. The table also includes species identified by the USFWS, primarily those listed in Jamesan, Tranquillity, Coit Ranch, Mendota Dam, and Firebaugh USGS quadrangles. Included are species that CDFG and USFWS have identified in comments to the EA for the 2001 pumping program (Reclamation 2001) and in personal communications. Species most likely to be found in upland desert habitats were not included. Desert habitats do not occur is this highly agricultural area. Plant species that CDFG and USFWS have identified are listed in Table 3-13.

Wetland/aquatic and riparian species are most likely to be affected by changes in water quality. These impacts could occur directly to the organism or their habitat, or indirectly such as impacts on their foodbase. Terrestrial or grassland species could be affected by increased flooding due to land subsidence. Some species, such as the giant garter snake, utilize both aquatic and upland habitats. Giant garter snakes utilize wetland areas during their active season, but move to higher elevation uplands for cover and refuge from floodwaters during their dormant season in the winter.

3.8 LAND USE

All MPG irrigated lands, in the WWD and SLWD, are located in western Fresno County. In the Fresno County General Plan, the area containing the MPG farmlands in WWD and SLWD is designated as the Westside Valley Area. This area is generally bounded by the Coast Ranges to the west, the Fresno Slough to the east, and the county borders to the north and south. Also included in the Project area of effect is a small area of southwestern Madera County along the Chowchilla Bypass north of the San Joaquin River (Figure 1-3). This area is located in the San Joaquin Valley portion of Madera County.

Lands in these areas of Fresno and Madera Counties are predominately used for agriculture and irrigated agriculture. Agriculture is a significant part of the economic base for the county. Specific crop patterns change in response to market demands, but significant acreage is devoted to permanent crops such as orchards and vineyards.

3.9 TRANSPORTATION

Fresno County is a regional hub for business and industry in the San Joaquin Valley. It is centrally located between the San Francisco and Los Angeles metropolitan regions. Its location attracts businesses that produce agricultural and non-agricultural products for distribution to other parts of the state and the country, as well as businesses that support agriculture and transport/distribution industries. Interstate-5 provides access to north-south travel throughout the state and Highway 180 provides east-west travel through Fresno County and access to Highway 99. Transportation in the immediate Project area is provided by a network of rural county roads.

3.10 AIR QUALITY

The Mendota Pool is located within the San Joaquin Valley Air Basin. Comprising about 24,840 square miles, the air basin represents approximately 16% of the geographic area of California and is the second largest air basin in the state. Major urban centers in the air basin include Bakersfield, Fresno, Modesto, and Stockton.

Air quality is regulated by both federal and California Ambient Air Quality Standards (AAQS). Federal AAQS establish primary and secondary national AAQS. National primary standards define air quality levels that are protective of public health, while the secondary standards are protective of public welfare (i.e., they prevent degradation of the environment, impaired visibility, damage to vegetation and property, etc.).

The San Joaquin Valley Air Basin has a Mediterranean climate generally consisting of hot dry summers and cool wet winters. Approximately 90% of the rainfall occurs between November and April, with little to no precipitation from late spring to early fall. Semi-permanent systems of high barometric pressure from fronts frequently establish over the air basin, deflecting low pressure systems that might otherwise bring cleansing rain and wind. The strength and duration of the inversion determines the amount of atmospheric mixing that will occur, which subsequently contributes to PM10 concentrations in the air basin (SJVUAPCD 1994). Coupled with the topography, the prevailing summer climate conditions allow small particles of man-made compounds, as well as soot, ash and dust to become suspended in the air and subsequently trapped by the surrounding mountains.[2]

The San Joaquin Valley Air Basin has recently been reclassified from a serious nonattainment area to a severe nonattainment area as a result of its failure to meet federal AAQS for ozone, making the San Joaquin Valley one of the most polluted parts of the country. This San Joaquin Valley Air Pollution Control District alleges that its failure to attain the federal AAQS is in part due to air emissions generated in the Bay Area. Based on a 1994 San Joaquin Valley Air Quality Study, ozone emissions are transported from the Bay Area to the San Joaquin Valley via the Altamont Pass, thus contributing to emissions in the San Joaquin Valley[3].

3.11 NOISE

Magnitude and frequency of environmental noise vary considerably over the course of the day and throughout the week, caused in part by changing conditions and the effects of seasonal vegetative covers. Two measures of sound level used by federal agencies for the time-varying quality of environmental noise are the equivalent sound level (L_{eq}) and the average day/night sound level (L_{dn}). The L_{eq} is an A-weighted sound level containing the same sound energy as the instantaneous sound levels measured over a specific time period. The L_{dn} takes into account the duration and time of day that a noise is encountered. Late night and early morning noise levels are adjusted by adding 10 decibels (dBA) to the measurement. Daytime noise levels are not adjusted. After adjustment, the hourly values are used to determine a 24-hour average sound level.

The U.S. Environmental Protection Agency (EPA) has identified 55 dBA as being the maximum sound level that will not adversely affect public health and welfare by interfering with speech or other activities in outdoor areas. Noise attributed to any additional groundwater pump operation must not exceed a L_{dn} for 55 dBA at any pre-existing noise-sensitive areas (schools, hospitals, or residences). A L_{dn} of 55 dBA is the evaluation threshold for noise impacts.

The City of Mendota is approximately 1 mile west of the nearest Mendota Pool production well. Most of the lands near the project area are used for agricultural production with few, if any, residences in close proximity to any production wells.

3.12 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

The project is located in unincorporated Fresno County generally referred to as the Westside Valley Area of the county. The study area for evaluation of socioeconomic impacts include incorporated cities of Firebaugh, Mendota, San Joaquin, and Huron. These communities are within commuting distances to the MPG irrigated lands. The study area does not include

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2 About the District, The Air Quality Mission, http://www.valleyair.org/General_info/aboutdist.htm)

3 Valley Air District to sue state over smog drift from Bay Area, February 20, 2002, San Joaquin Valley Air Polluton Control District Media Release, http://www.valleyair.org/Recent_news/Media_releases/lawsuitmediarelease.pdf.)

communities outside of Fresno County because socioeconomic impacts are expected to be related primarily to agricultural employment nearest to the MPG irrigated lands.

Demographic and economic data for the western Fresno region was compiled from the U.S. Census Bureau and the California Department of Finance. Unless otherwise noted, all data presented below are from the U.S. Census 2000 estimates.

3.12.1 POPULATION

Project lands are located in unincorporated Fresno County, in an area characterized by low population density. The project lands are located in four census county subdivisions with a total population of approximately 40,000 persons. The total population of Fresno County in 2000 was approximately 800,000 with over 80 percent of the population living in urbanized areas. According to the 2000 census, about 36 percent of the total county population was under 19; about 54 percent was between the ages of 19 and 64; and about 10 percent was over the age of 64.

Huron is the largest city in the study area with a population of 13,105 (2000). The second largest city is Mendota with a population of 10,028 (2000). The study area had a total population of 39,390 of which 4,545 persons were inmates in the State prison. Residents in the study area showed a slightly larger number of persons per household (4 versus 3) and higher proportion of minorities compared to the county (over 87 percent versus 44 percent). The western valley area of the county also has a higher percentage of families in poverty, 32 percent, compared to the county at 18 percent. Overall unemployment in the cities (Firebaugh, Mendota, San Joaquin, and Huron) in 2001 ranged between 10 and 34 percent, without seasonal adjustment. This is generally higher than the county's 13 percent unemployment in the same year. This is potentially due to seasonal nature of agricultural employment.

3.12.2 INDUSTRY

Agriculture is the largest industry in Fresno County. In 2000, Fresno County was ranked number one in the state for its agricultural production value, which was estimated at nearly 3.5 million dollars. Nearly 50 percent of the county land area is devoted to farms.

3.12.3 ENVIRONMENTAL JUSTICE

The memorandum accompanying Executive Order 12898 identifies that one method to consider environmental justice under NEPA is to address, whenever feasible, significant and adverse environmental effects of proposed federal actions on minority populations, low-income populations, and Indian tribes. In addition, each Federal agency must provide opportunities for effective community participation in the NEPA process.

The market for seasonal workers on local farms draws thousands of migrant workers, commonly of Hispanic origin. The population of some small communities typically increases during harvest.

Table 3-1. Monthly Climate Summary for Five Points Weather Station[1].

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	54.70	62.90	68.20	75.60	84.30	92.20	96.80	94.50	88.80	79.60	64.80	54.40	76.40
Mean Temperature (F)	45.50	51.20	55.00	60.30	67.50	74.70	79.50	78.00	73.10	64.80	53.00	45.10	62.30
Average Min. Temperature (F)	36.30	39.50	41.80	45.00	50.70	57.20	62.10	61.50	57.40	49.90	41.30	35.80	48.20
Maximum Total Precipitation (in.)	4.91	4.50	3.56	1.58	0.93	2.50	0.40	0.36	2.64	1.08	3.09	2.38	14.57
Average Total Precipitation (in.)	1.31	1.21	1.06	0.50	0.14	0.15	0.03	0.03	0.26	0.29	0.83	0.86	6.67
Minimum Total Precipitation (in.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.95
Evapotranspiration (inches)[2]	1.27	2.00	3.95	6.11	7.74	8.46	8.69	7.96	6.18	4.51	2.35	1.17	60.39

[1]NCDC 1961-1990 Minthly Normals (Western Regional Climate Center, http://www.wrcc.dri.edu/; 5/24/2002)

[2]Five Points (California Irrigation Management System, http://www.cimis.water.ca.gov/, 5/24/2002)

Table 3-2. Summary Water Budget for the Mendota Pool (May-September, 1997-2001)

Component	1997 Inflow (cfs)	1997 Outflow (cfs)	1998[a] Inflow (cfs)	1998[a] Outflow (cfs)	1999 Inflow (cfs)	1999 Outflow (cfs)	2000 Inflow (cfs)	2000 Outflow (cfs)	2001 Inflow (cfs)	2001 Outflow (cfs)
Northern Pool										
San Joaquin River	116.5		660.8		97.3		43.7			
Delta-Mendota Canal	2004.5		896.4		1945.2		1912.2			
MPG Wells in FWD	22.4		0.0		12.3		27.3			
Exchange Contractors		1336.0		1463.9		1344.0		1275.7		
SLCC Arroyo Canal		348.8		417.7		408.0		380.5		
San Joaquin River		-0.4		1840.0		2.8		9.7		
Newhall Land & Farming		23.9		7.9		4.2		3.0		
Evaporation		3.2		2.5		2.8		2.2		
Seepage[c]		8.0		8.0		8.0		8.0		
Totals for Northern Pool	**2143.5**	**1719.5**	**1557.2**	**3740.0**	**2054.9**	**1769.8**	**1983.2**	**1679.2**		
Southern Pool										
MPG Wells Along Fresno Slough	79.7		4.2		51.3		66.6		62.5	
James Bypass	0.0		2362.6		0.0		0.0		0.0	
James & Tranquillity ID, Fresno Slough WD	0.0		0.0		0.5		5.9		9.6	
James & Tranquillity ID		225.2		115.5		188.8		182.9		159.3
Mendota Wildlife Area		43.0		27.8		46.2		51.4		50.4
Lateral 6&7		46.6		63.2		42.8		22.7		23.6
Other[b]		35.5		18.6		13.3		27.2		36.8
Evaporation		16.0		12.2		13.7		11.0		14.6
Seepage[c]		39.3		39.3		39.3		39.3		39.3
Totals for Southern Pool	**79.7**	**405.6**	**2366.9**	**276.5**	**51.9**	**344.1**	**72.6**	**334.6**	**72.1**	**324**

[a] 1998 was a wet year with significant inflows from the San Joaquin River and the James Bypass throughout the irrigation season.
[b] Includes Terra Linda Farms, Coelho/Gardner/Hanson, Meyers Farming, Reclamation District 1606, Hughes, Melvin, Wilson, and Fresno Slough Water District.
[c] Seepage was estimated based on measurements made over a 2-day period in November 1999, and was assumed to be constant.

Table 3-3. Most Recent Surface Water Quality Laboratory Results

Sample		EC	TDS	pH	SAR	As	B	Mo	Se
Date	Lab[1]	(µmhos/cm @25°C)	(mg/l)		(mg/l)	(ug/L)	(mg/L)	(ug/L)	(ug/L)
San Joaquin River Arm									
Columbia Canal									
07/19/2001	FGL	421	-	-	-	-	-	-	-
09/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
10/03/2001	BSK	630	-	-	-	-	0.2	-	DQO
06/25/2002	FGL	383	240	7.8	1.6	3	0.16	-	-
06/25/2002	OBL	-	-	-	-	-	-	5.1	0.71
Minimum detected value or detection limit		**383**	**240**	**7.8**	**1.6**	**3**	**0.16**	**5.1**	**0.71**
Maximum detected value		**660**	**240**	**7.8**	**1.6**	**3**	**0.20**	**5.1**	**0.71**
Mean of detected values		**524**	**240**	**7.8**	**1.6**	**3**	**0.19**	**5.1**	**0.71**
Northern Fresno Slough									
Mendota Dam									
07/19/2001	FGL	390	-	-	-	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	<0.25	3.4	0.59
11/05/2001	FGL	668	380	8.0	2.7	<2	0.25	-	-
11/05/2001	OBL	-	-	-	-	-	-	2.8	0.59
06/25/2002	FGL	344	210	7.9	1.4	3	0.15	-	-
06/25/2002	OBL	-	-	-	-	-	-	1.6	0.68
CCID Main Canal									
01/03/2001	USBR	222	-	7.9	-	-	-	-	-
01/03/2001	OBL	-	-	-	-	-	-	-	0.65
02/07/2001	USBR	595	-	7.7	-	-	-	-	-
02/07/2001	OBL	-	-	-	-	-	-	-	1.08
03/08/2001	USBR	562	-	7.7	-	-	-	-	-
03/08/2001	OBL	-	-	-	-	-	-	-	2.32
04/03/2001	USBR	778	-	-	-	-	-	-	-
04/03/2001	OBL	-	-	-	-	-	-	-	2.96
05/09/2001	USBR	513	-	-	-	-	-	-	-
05/09/2001	OBL	-	-	-	-	-	-	-	0.56
06/06/2001	USBR	488	-	-	-	-	-	-	-
06/06/2001	OBL	-	-	-	-	-	-	-	0.99
06/26/2001	USBR	452	-	-	-	-	-	-	-
06/26/2001	OBL	-	-	-	-	-	-	-	<0.4
07/19/2001	FGL	410	-	-	-	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	<0.25	3.6	0.6
07/24/2001	USBR	423	-	-	-	-	-	-	-
07/24/2001	OBL	-	-	-	-	-	-	-	0.89
08/29/2001	USBR	639	-	-	-	-	-	-	-
08/29/2001	OBL	-	-	-	-	-	-	-	0.78
09/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
10/02/2001	USBR	720	-	-	-	-	-	-	-
10/02/2001	OBL	-	-	-	-	-	-	-	0.48
10/03/2001	BSK	630	-	-	-	-	0.2	-	DQO
10/30/2001	USBR	666	-	-	-	-	-	-	-
10/30/2001	OBL	-	-	-	-	-	-	-	<0.4

Table 3-3. Most Recent Surface Water Quality Laboratory Results

Sample		EC	TDS	pH	SAR	As	B	Mo	Se
Date	Lab[1]	(µmhos/cm @25°C)	(mg/l)		(mg/l)	(ug/L)	(mg/L)	(ug/L)	(ug/L)
11/05/2001	FGL	657	390	8.0	2.8	<2	0.21	-	-
11/05/2001	OBL	-	-	-	-	-	-	3.3	0.57
12/05/2001	USBR	982	-	-	-	-	-	-	-
12/05/2001	OBL	-	-	-	-	-	-	-	0.82
01/08/2002	USBR	698	-	-	-	-	-	-	-
02/07/2002	USBR	197	-	-	-	-	-	-	-
06/25/2002	FGL	387	240	7.9	1.5	3	0.17	-	-
06/25/2002	OBL	-	-	-	-	-	-	4.2	0.79
Mowry Bridge									
07/19/2001	FGL	430	-	-	-	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	<0.25	3.6	0.7
11/05/2001	FGL	652	370	7.9	2.8	<2	0.2	-	-
11/05/2001	OBL	-	-	-	-	-	-	2.62	0.51
06/25/2002	FGL	359	250	7.7	0.1	2	0.17	-	-
06/25/2002	OBL	-	-	-	-	-	-	1.3	0.81
DMC Check 21									
01/03/2001	USBR	358	-	7.7	-	-	-	-	-
01/03/2001	OBL	-	-	-	-	-	-	-	<0.4
02/07/2001	USBR	570	-	7.8	-	-	-	-	-
02/07/2001	OBL	-	-	-	-	-	-	-	1.75
03/08/2001	USBR	543	-	7.7	-	-	-	-	-
03/08/2001	OBL	-	-	-	-	-	-	-	2.38
04/03/2001	USBR	857	-	-	-	-	-	-	-
04/03/2001	OBL	-	-	-	-	-	-	-	3.32
05/09/2001	USBR	524	-	-	-	-	-	-	-
05/09/2001	OBL	-	-	-	-	-	-	-	0.84
06/06/2001	USBR	495	-	-	-	-	-	-	-
06/06/2001	OBL	-	-	-	-	-	-	-	0.86
06/26/2001	USBR	434	-	-	-	-	-	-	-
06/26/2001	OBL	-	-	-	-	-	-	-	<0.4
07/19/2001	FGL	418	-	-	-	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	<0.25	3.1	0.67
07/24/2001	USBR	469	-	-	-	-	-	-	-
07/24/2001	OBL	-	-	-	-	-	-	-	0.8
08/29/2001	USBR	620	-	-	-	-	-	-	-
08/29/2001	OBL	-	-	-	-	-	-	-	0.66
09/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
09/20/2001	FGL	770	479	8.1	3.6	3	0.25	2	DQO
10/02/2001	USBR	686	-	-	-	-	-	-	-
10/02/2001	OBL	-	-	-	-	-	-	-	0.48
10/03/2001	BSK	570	-	-	-	-	0.2	-	DQO
10/30/2001	USBR	676	-	-	-	-	-	-	-
10/30/2001	OBL	-	-	-	-	-	-	-	<0.4
11/05/2001	FGL	651	380	7.9	2.8	<2	0.2	-	-
11/05/2001	OBL	-	-	-	-	-	-	2.98	0.5
12/05/2001	USBR	767	-	-	-	-	-	-	-

Table 3-3. Most Recent Surface Water Quality Laboratory Results

Sample		EC	TDS	pH	SAR	As	B	Mo	Se
Date	Lab[1]	(µmhos/cm @25°C)	(mg/l)		(mg/l)	(ug/L)	(mg/L)	(ug/L)	(ug/L)
12/05/2001	OBL	-	-	-	-	-	-	-	1.56
01/08/2002	USBR	687	-	-	-	-	-	-	-
02/07/2002	USBR	698	-	-	-	-	-	-	-
06/05/2002	FGL	504	320	7.9	1.9	-	0.24	-	-
06/05/2002	OBL	-	-	-	-	-	-	1.0	1.19
06/25/2002	FGL	340	220	7.7	0.1	<2	0.15	-	-
06/25/2002	OBL	-	-	-	-	-	-	1.3	0.78
07/09/2002	FGL	321	210	8.0	1.4	-	0.15	-	-
08/09/2002	FGL	474	270	7.5	2.4	2	0.13	-	-
08/09/2002	OBL	-	-	-	-	-	-	<1.0	0.79
09/08/2002	FGL	535	304	7.8	2.4	-	0.14	-	-
09/20/2002	FGL	623	360	-	-	-	-	-	-
CCID Outside Canal									
01/03/2001	USBR	592	-	7.8	-	-	-	-	-
01/03/2001	OBL	-	-	-	-	-	-	-	<0.4
02/07/2001	USBR	514	-	7.8	-	-	-	-	-
02/07/2001	OBL	-	-	-	-	-	-	-	1.1
03/08/2001	USBR	550	-	7.7	-	-	-	-	-
03/08/2001	OBL	-	-	-	-	-	-	-	2.18
04/03/2001	USBR	683	-	-	-	-	-	-	-
04/03/2001	OBL	-	-	-	-	-	-	-	2.69
05/09/2001	USBR	525	-	-	-	-	-	-	-
DMC Check 21 (cont'd)									
05/09/2001	OBL	-	-	-	-	-	-	-	0.95
06/06/2001	USBR	463	-	-	-	-	-	-	-
06/06/2001	OBL	-	-	-	-	-	-	-	0.92
06/26/2001	USBR	445	-	-	-	-	-	-	-
06/26/2001	OBL	-	-	-	-	-	-	-	<0.4
07/19/2001	FGL	417	-	-	-	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	<0.25	3.8	0.69
07/24/2001	USBR	479	-	-	-	-	-	-	-
07/24/2001	OBL	-	-	-	-	-	-	-	1.0
08/29/2001	USBR	624	-	-	-	-	-	-	-
08/29/2001	OBL	-	-	-	-	-	-	-	0.93
09/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
10/02/2001	USBR	731	-	-	-	-	-	-	-
10/02/2001	OBL	-	-	-	-	-	-	-	0.4
10/03/2001	BSK	680	-	-	-	-	0.2	-	DQO
10/30/2001	USBR	667	-	-	-	-	-	-	-
10/30/2001	OBL	-	-	-	-	-	-	-	0.49
11/05/2001	FGL	662	370	8.0	2.9	<2	0.2	-	-
11/05/2001	OBL	-	-	-	-	-	-	2.48	0.51
12/05/2001	USBR	866	-	-	-	-	-	-	-
12/05/2001	OBL	-	-	-	-	-	-	-	0.68
01/08/2002	USBR	887	-	-	-	-	-	-	-
02/07/2002	USBR	336	-	-	-	-	-	-	-

Table 3-3. Most Recent Surface Water Quality Laboratory Results

Sample		EC	TDS	pH	SAR	As	B	Mo	Se
Date	Lab[1]	(µmhos/cm @25°C)	(mg/l)		(mg/l)	(ug/L)	(mg/L)	(ug/L)	(ug/L)
06/25/2002	FGL	387	250	7.7	0.1	<2	0.17	-	-
06/25/2002	OBL	-	-	-	-	-	-	1.9	0.83
Firebaugh Intake Canal									
07/19/2001	FGL	423	-	-	-	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	<0.25	3.5	0.67
09/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
10/03/2001	BSK	590	-	-	-	-	0.2	-	DQO
11/05/2001	FGL	664	390	8.0	2.8	<2	0.22	-	-
11/05/2001	OBL	-	-	-	-	-	-	3.1	0.46
06/25/2002	FGL	401	260	7.9	0.1	2	0.18	-	-
06/25/2002	OBL	-	-	-	-	-	-	2.1	0.84
West of Fordel									
07/19/2001	FGL	390	-	-	-	-	-	-	-
11/05/2001	FGL	675	380	8.7	3.0	<2	0.2	-	-
11/05/2001	OBL	-	-	-	-	-	-	2.42	0.505
06/25/2002	FGL	358	220	8.7	0.1	3	0.16	-	-
06/25/2002	OBL	-	-	-	-	-	-	1.4	0.71
Minimum detected value or detection limit		**197**	**210**	**7.5**	**0.1**	**2**	**0.13**	**1.00**	**<0.4**
Maximum detected value		**982**	**479**	**8.7**	**3.6**	**3**	**0.25**	**4.20**	**3.32**
Mean of detected values		**560**	**313**	**7.9**	**1.8**	**3**	**0.19**	**2.61**	**0.99**
Central Fresno Slough									
Etchegoinberry									
07/19/2001	FGL	423	-	-	-	-	-	-	-
11/05/2001	FGL	854	500	8.2	4.7	<2	0.3	-	-
11/05/2001	OBL	-	-	-	-	-	-	4.05	0.47
06/25/2002	FGL	439	280	8.0	1.9	3	0.18	-	-
06/25/2002	OBL	-	-	-	-	-	-	2.4	0.67
Minimum detected value or detection limit		**423**	**280**	**8.0**	**1.9**	**<2**	**0.18**	**2.40**	**0.47**
Maximum detected value		**854**	**500**	**8.2**	**4.7**	**3**	**0.30**	**4.05**	**0.67**
Mean of detected values		**572**	**390**	**8.1**	**3.3**	**3**	**0.24**	**3.23**	**0.57**
Southern Fresno Slough									
Mendota Wildlife Area[2]									
01/31/2001	FGL	853	540	7.8	4.3	-	0.28	-	-
02/22/2001	FGL	682	430	7.8	2.7	-	0.33	-	-
03/28/2001	FGL	670	440	7.9	3.1	-	0.35	-	-
04/25/2001	FGL	772	490	8.2	4.0	-	0.41	-	-
05/30/2001	FGL	1,030	650	8.5	6.1	<2	0.32	6	DQO
06/26/2001	FGL	711	457	8.4	4.1	2	0.26	4	DQO
07/19/2001	FGL	573	367	8.8	3.2	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	0.2	4.2	0.62
08/15/2001	FGL	660	430	9.0	4.0	2	0.21	3	DQO
09/10/2001	FGL	1,010	600	-	-	-	-	-	-
09/20/2001	FGL	777	492	8.7	4.3	2	0.21	3	DQO
11/05/2001	FGL	1060	610	8.4	6.2	<2	0.33	-	-

Table 3-3. Most Recent Surface Water Quality Laboratory Results

Sample		EC	TDS	pH	SAR	As	B	Mo	Se
Date	Lab[1]	(μmhos/cm @25°C)	(mg/l)		(mg/l)	(ug/L)	(mg/L)	(ug/L)	(ug/L)
11/05/2001	OBL	-	-	-	-	-	-	8.42	<0.4
06/05/2002	FGL	678	440	8.4	3.3	-	0.22	-	-
06/05/2002	OBL	-	-	-	-	-	-	2.0	0.73
06/25/2002	FGL	667	410	8.6	0.1	<2	0.23	-	-
06/25/2002	OBL	-	-	-	-	-	-	3.0	0.7
07/09/2002	FGL	533	340	8.6	2.9	-	0.20	-	-
07/15/2002	FGL	514	330	-	-	-	-	-	DQO
07/25/2002	FGL	500	280	-	-	-	-	-	-
08/09/2002	FGL	659	400	8.4	3.9	<2	0.17	-	-
08/09/2002	OBL	-	-	-	-	-	-	2.2	0.54
08/14/2002	FGL	613	370	-	-	-	-	-	-
08/19/2002	FGL	658	400	-	-	-	-	-	-
09/08/2002	FGL	849	515	8.3	4.2	-	0.3	-	-
09/20/2002	FGL	824	500	-	-	-	-	-	-
Lateral 6 & 7									
01/31/2001	FGL	742	480	7.8	3.9	-	0.25	-	-
02/22/2001	FGL	787	500	8.4	3.5	-	0.27	-	-
03/28/2001	FGL	680	450	8.4	2.9	-	0.32	-	-
04/25/2001	FGL	718	480	8.5	4.5	-	0.26	-	-
05/30/2001	FGL	1,020	650	8.4	5.2	<2	0.33	5	DQO
06/26/2001	FGL	820	529	9.0	4.5	4	0.33	6	DQO
07/19/2001	FGL	677	446	8.7	3.8	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	0.23	5.5	0.69
08/15/2001	FGL	685	440	8.7	4.5	3	0.21	3	DQO
09/20/2001	FGL	1,020	650	8.4	5.7	3	0.27	5	DQO
11/05/2001	FGL	889	560	8.5	4.8	<2	0.26	-	-
11/05/2001	OBL	-	-	-	-	-	-	5.42	0.475
06/05/2002	FGL	720	470	8.2	3.5	-	0.25	-	-
06/05/2002	OBL	-	-	-	-	-	-	1.0	0.9
07/09/2002	FGL	459	300	8.2	2.3	-	0.23	-	-
07/15/2002	FGL	533	340	-	-	-	-	-	DQO
07/25/2002	FGL	522	310	-	-	-	-	-	-
08/09/2002	FGL	675	420	8.0	3.8	2	0.21	-	-
08/09/2002	OBL	-	-	-	-	-	-	1.6	0.512
08/14/2002	FGL	680	390	-	-	-	-	-	-
08/19/2002	FGL	680	410	-	-	-	-	-	-
09/08/2002	FGL	742	451	8.2	3.7	-	0.2	-	-
09/20/2002	FGL	874	540	-	-	-	-	-	-
James ID (Booster Plant)									
01/31/2001	FGL	710	450	8.2	4.2	-	0.3	-	-
03/28/2001	FGL	805	510	8.6	4.1	-	0.35	-	-
04/25/2001	FGL	826	550	8.4	6.4	-	0.37	-	-
05/30/2001	FGL	824	540	8.7	5.7	10	0.38	8	DQO
06/26/2001	FGL	784	514	8.7	4.4	2	0.29	5	DQO
07/19/2001	FGL	665	442	8.6	3.8	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	0.23	4.9	0.57

Table 3-3. Most Recent Surface Water Quality Laboratory Results

Sample		EC	TDS	pH	SAR	As	B	Mo	Se
Date	Lab[1]	(µmhos/cm @25°C)	(mg/l)		(mg/l)	(ug/L)	(mg/L)	(ug/L)	(ug/L)
08/15/2001	FGL	687	440	8.5	3.9	3	0.21	3	DQO
09/20/2001	FGL	1,030	656	8.2	5.6	3	0.28	5	DQO
11/05/2001	FGL	933	580	8.4	4.8	<2	0.27	-	-
11/05/2001	OBL	-	-	-	-	-	-	6.68	0.585
06/05/2002	FGL	708	440	8.0	3.4	-	0.25	-	-
06/05/2002	OBL	-	-	-	-	-	-	2.0	0.95
07/09/2002	FGL	463	300	8.3	2.4	-	0.22	-	-
07/15/2002	FGL	530	320	-	-	-	-	-	DQO
07/25/2002	FGL	512	310	-	-	-	-	-	-
08/09/2002	FGL	672	420	7.7	2.5	2	0.13	-	-
08/09/2002	OBL	-	-	-	-	-	-	1.2	0.638
08/14/2002	FGL	666	390	-	-	-	-	-	-
08/19/2002	FGL	671	400	-	-	-	-	-	-
09/08/2002	FGL	737	470	8.1	3.6	-	0.22	-	-
09/20/2002	FGL	860	510	-	-	-	-	-	-
Tranquillity ID Intake									
07/25/2002	FGL	540	320	-	-	-	-	-	DQO
08/09/2002	FGL	712	410	-	-	-	-	-	DQO
08/14/2002	FGL	703	420	-	-	-	-	-	DQO
08/19/2002	FGL	672	390	-	-	-	-	-	DQO
09/08/2002	FGL	1570	925	8.0	12.2	-	1.29	-	DQO
09/20/2002	FGL	1790	1080	-	-	-	-	-	DQO
Minimum detected value or detection limit		**459**	**280**	**7.7**	**0.1**	**<2**	**0.13**	**1.00**	**<0.4**
Maximum detected value		**1,790**	**1,080**	**9.0**	**12.2**	**10**	**1.29**	**8.42**	**0.95**
Mean of detected values		**754**	**470**	**8.4**	**4.2**	**3**	**0.29**	**4.16**	**0.66**

1. Laboratory Abbreviations: BSK - BSK Analytical Laboratories, Fresno, CA; FGL - Fruit Growers Laboratory, Santa Paula, CA; USBR - U.S. Bureau of Reclamation, hydrolab field measurement (EC), OBL - Olson Biochemistry Lab, Brookings, SD; OBL - Olson Biochemistry Lab, Brookings, SD
2. Until the EC analysis on 11/18/2000, samples were taken one mile south of Whitesbridge Road. From the complete chemical analysis (11/18/2000) until 4/25/2001 samples were taken at Whitesbridge Road. Subsequent samples were taken one quarter mile south of Whitesbridge Road. The sample taken on 8/15/2001 and subsequent samples were taken at Whitesbridge Road.

DQO = Data quality objectives for this analysis were not met for this sample. Results are not included in the EIS evaluation of this parameter.Results are reported in Appendix C.

Table 3-4. Relevant Water and Sediment Quality Screening Benchmarks for Selected Constituents or Parameters

Parameter	Target Value[1]	Severe or Unacceptable Value[2]	Reference	Notes
Drinking Water Protection Criteria				
Arsenic	50 µg/L		Marshack, 2000	Primary MCL
Boron	630 µg/L		Marshack, 2000	U.S. EPA IRIS reference dose
Molybdenum	35 µg/L		Marshack, 2000	U.S. EPA IRIS reference dose
Selenium	50 µg/L		Marshack, 2000	Primary MCL
Electrical Conductivity	900 µS/cm		DWR, 2000	Recommended Secondary MCL
Total Dissolved Solids	500 mg/L		Marshack, 2000	Secondary MCL
Irrigation Water Objectives				
Arsenic	100 µg/L		Ayers & Westcott, 1985	Food and Agriculture Organization of the United Nations Toxicity to plants varies widely, ranging from 12 mg/l for Sudan grass to less than 0.05 mg/l for rice.
Boron	700 µg/L	3000 µg/L	Ayers & Westcott, 1985	Food and Agriculture Organization of the United Nations
Selenium	20 µg/L		Ayers & Westcott, 1985	Food and Agriculture Organization of the United Nations Toxic to plants at concentrations as low as 0.025 mg/l and toxic to livestock if forage is grown in soils with relatively high levels of added selenium. An essential element to animals but in very low concentrations
Electrical Conductivity	700 µS/cm	3000 µS/cm	Ayers & Westcott, 1985	Food and Agriculture Organization of the United Nations
Total Dissolved Solids	450 mg/L	2000 mg/L	Ayers & Westcott, 1985	Food and Agriculture Organization of the United Nations
Sodium Adsorption Ratio			Ayers & Westcott, 1985	Food and Agriculture Organization of the United Nations
SAR = 0-3 and EC =	>700 µS/cm	<200 µS/cm		
SAR = 3-6 and EC=	>1200 µS/cm	<300 µS/cm		
SAR = 6-12 and EC=	>1900 µS/cm	<500 µS/cm		
Sediment Objectives				
Arsenic	12.1 mg/kg d.w.	49.6 mg/kg d.w.	US EPA 1996	Effects Range Low; Severe=Effects range median (Hyalella azteca)
Selenium	2 mg/kg d.w.	4 mg/kg d.w.	Reclamation, 2000	Draft Environmental Impact Statement (EIS)/Environmental Impact Report (EIR): Grassland Bypass Project, 2001-2009 (Reclamation 2000)

Table 3-4. Relevant Water and Sediment Quality Screening Benchmarks for Selected Constituents or Parameters

Parameter	Target Value[1]	Severe or Unacceptable Value[2]	Reference	Notes
Refuge Water Supply Objectives				
Arsenic	5 µg/L	10 µg/L	CDFG, 2001	Preliminary Draft Water Quality Objectives for Refuge Water Supplies (11/14/1995) (Title 34, P.L. 102-575, Section 3406(d))
Boron	300 µg/L	600 µg/L	CDFG, 2001	Proposed California Regional Water Quality Control Board Boron and Salinity Objectives for Full Protection of Beneficial Uses in the Lower San Joaquin River at Vernalis.
Molybdenum	10 µg/L	19 µg/L	CDFG, 2001	Preliminary Draft Water Quality Objectives for Refuge Water Supplies (11/14/1995) (Title 34, P.L. 102-575, Section 3406(d))
Selenium	2 µg/L	5 µg/L	CDFG, 2001	Draft Environmental Impact Statement (EIS)/Environmental Impact Report (EIR): Grassland Bypass Project, 2001-2009 (Reclamation 2000)
Total Dissolved Solids	400 mg/L	800 mg/L	CDFG, 2001	Reclamation Water Contract # 14-OC-200-7859A for Refuge Water Supplies to Mendota WA. (5-year average; 1-year average = 450 mg/L; monthly average = 600 mg/L)
Electrical Conductivity	440 µmhos/cm	700-1000 µmhos/cm	CDFG, 2001	Proposed California Regional Water Quality Control Board Boron and Salinity Objectives for Full Protection of Beneficial Uses in the Lower San Joaquin River at Vernalis.
Aquatic Life Protection Criteria (Sacramento River and San Joaquin River Basin Plan)				
Arsenic	10 µg/L		CVRWQCB, 1998	Dissolved concentration
Boron	800 µg/L		CVRWQCB, 1998	Total concentration; Monthly mean, non-critical year
Electrical Conductivity	150 µS/cm		CVRWQCB, 1998	90th percentile; @25°C
Molybdenum	19 µg/L		CVRWQCB, 1998	Total concentration; Monthly mean
Selenium	2 µg/L		CVRWQCB, 1998	Total concentration; Monthly mean; same as Reclamation (2000)
Total Dissolved Solids	600 mg/L		CVRWQCB, 1998	Total concentration; Monthly mean; 90th percentile

[1] Target Value: Concentration below which no adverse effects are likely.
[2] Severe or Unacceptable Value: Concentration at which adverse or toxic effects may become evident.

Table 3-5. Deviations of Average Daily EC Measurements (μmhos/cm) at Canal Intakes from Concurrent Measurements at Check 21 on the DMC during 2000 and 2001

	CCID Main Canal	CCID Outside Canal	Columbia Canal	Firebaugh Canal	SLCC Arroyo Canal
<u>2000 Pumping Program</u>					
Outside of MPG Pumping Period					
Average	-61.7	25.0	48.3	-38.2	25.0
Minimum	-421.0	-43.0	-242.0	-383.0	-65.0
Maximum	130.0	91.0	206.0	140.0	111.0
During MPG Pumping Period					
Average	14.6	27.3	-38.8	9.1	19.9
Minimum	-23.0	-47.0	-352.0	-130.0	-182.0
Maximum	38.0	127.0	65.0	122.0	109.0
<u>2001 Pumping Program</u>					
Outside of MPG Pumping Period					
Average	41	25	86	33	51
Minimum	-143	-292	-78	-327	-445
Maximum	111	68	261	181	261
During MPG Pumping Period					
Average	50	11	50	30	53
Minimum	-225	-210	-235	-174	-146
Maximum	174	51	228	102	129

Note:
A negative value indicates that the water entering the canal has a lower EC than the water in the DMC

Table 3-6. Groundwater Pumpage and Change in Groundwater Levels in Westlands Water District

Crop Year	Pumpage	Elevation	Change in Groundwater Elevation (ft)
1976	97,000	-2	9
1977	472,000	-99	-97
1978	159,000	-4	95
1979	140,000	-13	-9
1980	106,000	4	17
1981	99,000	11	7
1982	105,000	32	21
1983	31,000	56	24
1984	73,000	61	5
1985	228,000	63	2
1986	145,000	71	8
1987	159,000	89	18
1988	160,000	64	-25
1989	175,000	63	-1
1990	300,000	9	-54
1991	600,000	-32	-41
1992	600,000	-62	-30
1993	225,000	1	63
1994	325,000	-51	-52
1995	150,000	27	78
1996	50,000	49	22
1997	30,000	63	14
1998	15,000	63	0
1999	20,000	65	2
2000	225,000	43	-22
2001	215,000	25	-18
2002	175,000		

Table 3-7. Most Recent Groundwater Quality Laboratory Results (Shallow Wells)

Well Owner & Well ID	Sample Date	Lab[a]	EC (umhos/cm @25^{o}C)	TDS (mg/L)	pH	SAR	As (ug/L)	B (mg/L)	Mo (ug/L)	Se (ug/L)
NORTHERN FRESNO SLOUGH										
MPG Production Wells										
Fordel, Inc.										
M-2	06/25/02	FGL	1150	690	6.8	5.1	3	0.44		
M-2	06/25/02	OBL	-	-	-	-	-	-	4.2	<0.4
M-3	06/28/01	FGL	1390	810	6.8	6.4	3	0.51	10.0	-
M-3	06/28/01	OBL	-	-	-	-	-	-	-	<0.4
M-4	10/01/01	FGL	1250	760	6.7	5.4	3	0.52	-	-
M-4	10/01/01	OBL	-	-	-	-	-	-	5.7	<0.4
M-5	10/01/01	FGL	769	480	6.9	3.4	<2	0.35	-	-
M-5	10/01/01	OBL	-	-	-	-	-	-	4.6	<0.4
M-6	06/25/02	FGL	650	390	6.7	2.1	3	0.26		
M-6	06/25/02	OBL							3.3	0.4
Terra Linda Farms										
TL-4A	10/02/01	FGL	935	570	7.6	2.9	<2	0.21	-	-
TL-4A	10/02/01	OBL	-	-	-	-	-	-	8.7	<0.4
TL-4C	06/25/02	FGL	1380	870	6.9	4.3	<2	0.41		
TL-4C	06/25/02	OBL							1.6	<0.4
TL-10A	09/12/01	FGL	896	560	7.6	3.5	<2	0.26	-	-
TL-10A	09/12/01	OBL	-	-	-	-	-	-	10.6	<0.4
TL-10B	09/12/01	FGL	989	580	7.5	3.6	3	0.25	-	-
TL-10B	09/12/01	OBL	-	-	-	-	-	-	10.2	<0.4
TL-10C	06/25/02	FGL	727	420	7.2	3.5	4	0.26		
TL-10C	06/25/02	OBL							11.5	<0.4
TL-11	09/12/01	FGL	774	450	7.6	3.7	<2	0.28	-	-
TL-11	09/12/01	OBL	-	-	-	-	-	-	13.7	<0.4
TL-16	10/01/01	FGL	921	550	7.7	2.4	<2	0.22	-	-
TL-16	10/01/01	OBL	-	-	-	-	-	-	6.9	<0.4
TL-17	06/25/02	FGL	926	580	6.7	3.6	3	0.31	-	-
TL-17	06/25/02	OBL	-	-	-	-	-	-	1.8	<0.4
Minimum detected value or detection limit			**650**	**390**	**6.7**	**2.1**	**<2**	**0.21**	**1.6**	**<0.4**
Maximum detected value			**1390**	**870**	**7.7**	**6.4**	**4**	**0.52**	**13.7**	**0.4**
Mean of detected values			**981**	**593**	**7.1**	**3.8**	**3**	**0.33**	**7.1**	**0.4**
CENTRAL FRESNO SLOUGH										
MPG Production Wells										
Coelho/Gardner/Hanson										
CGH-1A	06/27/02	FGL	1530	1000	6.9	4.0	<2	0.29	-	-
CGH-1A	06/27/02	OBL	-	-	-	-	-	-	1.1	<0.4
CGH-1B	10/17/02	FGL	1940	1200	7.1	-	<2	0.35	-	DQO
CGH-1C	09/10/01	FGL	944	580	7.0	4.3	<2	0.30	-	-
CGH-1C	09/10/01	OBL	-	-	-	-	-	-	4.9	<0.4
CGH-1C	10/17/02	FGL	1400	840	7.5	-	<2	0.31	-	-
CGH-2	06/27/02	FGL	-	-	7.3	8.9	<2	0.41	-	-
CGH-2	06/27/02	OBL	-	-	-	-	-	-	5.2	<0.4
CGH-2	08/19/02	FGL	2410	1490	-	-	-	-	-	-
CGH-2	10/17/02	FGL	2470	1510	7.1	-	<2	0.40	-	DQO
CGH-3	08/20/02	FGL	3410	2150	7.0	11.7	<2	0.54	-	-
CGH-3	08/20/02	OBL	-	-	-	-	-	-	7.7	<0.4
CGH-4	09/10/01	FGL	4250	2620	7.9	23.6	<2	0.98	-	-
CGH-4	09/10/01	OBL	-	-	-	-	-	-	16.0	<0.4
CGH-5	08/03/99	FGL	-	2130	8.0	16.4	<2	0.70	-	DQO
CGH-5	07/13/00	FGL	3290	-	-	-	-	-	-	-
CGH-5	10/17/02	FGL	4870	3000	-	-	<2	-	-	-
CGH-6A	06/27/01	FGL	-	-	-	-	<2	-	-	-
CGH-6A	08/20/02	FGL	3980	2480	7.4	12.3	-	0.75	-	-
CGH-6A	08/20/02	OBL	-	-	-	-	-	-	16.2	<0.4
CGH-6B	10/17/02	FGL	3390	2110	7.8	-	<2	0.54	-	DQO
CGH-6C	10/17/02	FGL	2290	1400	7.7	-	<2	0.46	-	-
CGH-6D	10/17/02	FGL	1990	1160	7.6	-	<2	0.46	-	-

Table 3-7. Most Recent Groundwater Quality Laboratory Results (Shallow Wells)

Well Owner & Well ID	Sample Date	Lab[a]	EC (umhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (ug/L)	B (mg/L)	Mo (ug/L)	Se (ug/L)
CGH-8	09/22/99	FGL	3000	-	-	-	-	-	-	-
CGH-9	06/27/02	FGL	2030	1290	7.6	11.1	<2	0.49	-	-
CGH-9	06/27/02	OBL	-	-	-	-	-	-	15.2	<0.4
CGH-10	08/19/02	FGL	1560	1010	7.6	11.1	<2	0.40	-	-
CGH-10	08/19/02	OBL	-	-	-	-	-	-	13.0	0.4
CGH-11	06/27/02	FGL	-	-	7.1	11.3	<2	0.80	-	-
CGH-11	06/27/02	OBL	-	-	-	-	-	-	15.5	<0.4
CGH-11	08/19/02	FGL	3320	2130	-	-	-	-	-	-
Meyers Farming										
MS-1	03/23/99	TL	-	2800	-	-	-	0.62	-	DQO
MS-1A	09/10/01	FGL	6570	4410	7.2	16.3	<2	1.12	15.4	-
MS-1A	09/10/01	OBL	-	-	-	-	-	-	-	<0.4
MS-2	09/10/01	FGL	5000	3050	7.8	17.7	<2	0.69	21.3	-
MS-2	09/10/01	OBL	-	-	-	-	-	-	-	<0.4
MS-3	09/10/01	FGL	3860	2290	7.9	25.3	<2	0.65	25.9	-
MS-3	09/10/01	OBL	-	-	-	-	-	-	-	<0.4
MS-4	09/10/01	FGL	2730	1790	7.7	14.0	<2	1.00	40.7	-
MS-4	09/10/01	OBL	-	-	-	-	-	-	-	<0.4
MS-6	06/27/02	FGL	-	-	8.0	12.7	<2	1.10	-	-
MS-6	06/27/02	OBL	-	-	-	-	-	-	41.2	<0.4
MS-6	08/21/02	FGL	3590	2210	-	-	-	-	-	-
MS-7	08/19/02	FGL	2930	1890	7.3	14.0	<2	0.98	-	-
MS-7	08/19/02	OBL	-	-	-	-	-	-	38.7	<0.4
Terra Linda Farms										
TL-12	10/02/01	FGL	769	460	-	4.8	<2	0.28	7.3	-
TL-12	10/02/01	OBL	-	-	-	-	-	-	-	<0.4
TL-12	10/17/02	FGL	864	520	8.0	-	<2	0.24	-	-
TL-13	06/26/01	FGL	-	-	7.1	3.5	<2	0.26	4.0	-
TL-13	10/02/01	FGL	860	520	-	-	-	-	-	-
TL-13	10/02/01	OBL	-	-	-	-	-	-	-	<0.4
TL-14	06/26/02	FGL	1190	750	7.2	6.1	<2	0.24	-	-
TL-14	06/26/02	OBL	-	-	-	-	-	-	8.5	<0.4
TL-15	06/26/01	FGL	-	-	7.3	5.7	<2	0.28	10.0	-
TL-15	10/02/01	FGL	955	560	-	-	-	-	-	-
TL-15	10/02/01	OBL	-	-	-	-	-	-	-	<0.4
Silver Creek Packing Co.										
SC-3B	02/27/02	FGL	847	510	7.3	4.4	-	0.29	-	-
SC-3B	10/17/2002	FGL	1750	1020	6.9		<2	0.28	-	-
SC-4B	06/26/02	FGL	1420	840	6.7	5.0	<2	0.33	-	-
SC-4B	06/26/02	OBL	-	-	-	-	-	-	4.7	<0.4
Minimum detected value or detection limit			**769**	**460**	**6.7**	**3.5**	**<2**	**0.24**	**1.1**	**0.4**
Maximum detected value			**6570**	**4410**	**8.0**	**25.3**	**NA**	**1.12**	**41.2**	**0.4**
Mean of detected values			**2544**	**1616**	**7.4**	**11.1**	**NA**	**0.53**	**15.6**	**0.4**
SOUTHERN FRESNO SLOUGH										
MPG Production Wells										
Coelho West										
CW-1	09/12/01	FGL	-	-	-	-	<2	-	-	-
CW-1	08/21/02	FGL	1060	680	8.1	11.1	-	0.40	-	-
CW-1	08/21/02	OBL	-	-	-	-	-	-	13.7	<0.4
CW-2	06/25/02	FGL	-	-	-	-	<2	-	-	-
CW-2	06/25/02	OBL	-	-	-	-	-	-	19.7	<0.4
CW-2	08/21/02	FGL	1160	710	8.5	14.0	-	0.43	-	-
CW-3	06/25/01	FGL	-	-	-	-	<2	-	-	-
CW-3	08/21/02	FGL	1650	1020	8.1	16.9	-	0.56	-	-
CW-3	08/21/02	OBL	-	-	-	-	-	-	28.4	<0.4
CW-4	09/12/01	FGL	-	-	-	-	<2	-	-	-
CW-4	08/21/02	FGL	1600	1000	7.5	11.3	-	0.50	-	-
CW-4	08/21/02	OBL	-	-	-	-	-	-	18.2	0.9
CW-5	06/28/01	FGL	-	-	-	-	<2	-	-	-
CW-5	08/20/02	FGL	2640	1590	8.0	26.9	-	0.81	-	-
CW-5	08/20/02	OBL	-	-	-	-	-	-	44.2	<0.4

Table 3-7. Most Recent Groundwater Quality Laboratory Results (Shallow Wells)

Well Owner & Well ID	Sample Date	Lab[a]	EC (umhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (ug/L)	B (mg/L)	Mo (ug/L)	Se (ug/L)
Five Star										
FS-1	09/12/01	OBL	-	-	-	-	-	-	18.0	<0.4
FS-1	08/21/02	FGL	1160	710	7.9	7.1	<2	0.36	-	-
FS-2	10/03/01	FGL	1190	740	7.4	4.4	<2	0.36	-	-
FS-2	10/03/01	OBL	-	-	-	-	-	-	13.9	<0.4
FS-3	09/12/01	FGL	-	-	8.0	11.9	<2	0.50	-	-
FS-3	09/12/01	OBL	-	-	-	-	-	-	24.0	-
FS-3	10/02/01	FGL	1930	1200	-	-	-	-	-	-
FS-3	10/02/01	OBL	-	-	-	-	-	-	-	<0.4
FS-4	10/02/01	FGL	1740	1060	7.8	13.8	<2	0.50	-	-
FS-4	10/02/01	OBL	-	-	-	-	-	-	24.0	<0.4
FS-5	06/25/02	FGL	-	-	7.6	5.1	<2	0.31	-	-
FS-5	06/25/02	OBL	-	-	-	-	-	-	7.9	<0.4
FS-5	08/21/02	FGL	1200	740	-	-	-	-	-	-
FS-6	09/12/01	FGL	2340	1390	7.9	9.6	<2	0.52	-	-
FS-6	09/12/01	OBL	-	-	-	-	-	-	23.2	<0.4
FS-7	10/03/01	FGL	2500	1600	7.3	7.9	<2	0.53	-	-
FS-7	10/03/01	OBL	-	-	-	-	-	-	17.7	<0.4
FS-8	10/03/01	FGL	2240	1310	7.7	12.1	<2	0.60	-	-
FS-8	10/03/01	OBL	-	-	-	-	-	-	19.0	<0.4
FS-9	09/12/01	FGL	2090	1290	7.9	9.8	<2	0.56	-	-
FS-9	09/12/01	OBL	-	-	-	-	-	-	17.6	<0.4
FS-10	06/25/02	FGL	1630	1060	7.4	6.1	<2	0.39	-	-
FS-10	06/25/02	OBL	-	-	-	-	-	-	11.4	<0.4
Other Wells										
Meyers Farming										
P-1	06/28/01	FGL	4810	3380	7.7	13.7	2	0.89	50.0	-
P-1	06/28/01	OBL	-	-	-	-	-	-	-	<0.4
P-2	04/01/99	BSK	5800	4100	-	-	-	0.89	-	DQO
P-3	04/01/99	BSK	5300	3600	-	-	-	1.10	-	DQO
P-4	04/01/99	BSK	8900	6200	-	-	-	1.20	-	DQO
P-5	04/01/99	BSK	6000	4200	-	-	-	1.00	-	DQO
Minimum detected value or detection limit			**1060**	**680**	**7.3**	**4.4**	**<2**	**0.31**	**7.9**	**<0.4**
Maximum detected value			**8900**	**6200**	**8.5**	**26.9**	**2**	**1.20**	**50.0**	**0.9**
Mean of detected values			**2847**	**1879**	**7.8**	**11.4**	**2**	**0.62**	**21.9**	**0.9**
WEST OF FRESNO SLOUGH										
USGS										
31J4	06/27/01	FGL	5940	3490	7.0	15.8	<2	1.43	10.0	-
31J4	06/27/01	OBL	-	-	-	-	-	-	-	<0.4
10A2	09/28/99	FGL	6960	5750	7.2	4.7	2	4.10	-	DQO
Meyers Farming										
S-1	08/05/99	FGL	7470	5100	6.7	17.3	<2	1.40	-	DQO
S-2	08/05/99	FGL	7410	5560	6.9	19.8	<2	7.70	-	DQO
S-3	06/24/02	FGL	8220	6000	7.4	17.0	3	3.06	-	-
S-3	06/24/02	OBL	-	-	-	-	-	-	58.4	0.7
Minimum detected value or detection limit			**5940**	**3490**	**6.7**	**4.7**	**<2**	**1.40**	**10.0**	**<0.4**
Maximum detected value			**8220**	**6000**	**7.4**	**19.8**	**3**	**7.70**	**58.4**	**0.7**
Mean of detected values			**7200**	**5180**	**7.0**	**14.9**	**3**	**3.54**	**34.2**	**NA**
EAST OF FRESNO SLOUGH										
Meyers Farming										
MF-1[b]	03/26/02	FGL	2170	1370	7.0	6.4	DQO	0.20	-	DQO
MF-2[c]	03/26/02	FGL	2450	1500	7.1	8.0	DQO	0.29	-	DQO
MF-3	03/26/02	FGL	1810	1100	7.1	5.8	DQO	0.23	-	DQO
MF-4	03/27/02	FGL	2810	1580	6.9	6.3	DQO	0.28	-	DQO
MF-5	03/27/02	FGL	2750	1710	6.9	7.7	DQO	0.37	-	DQO

Table 3-7. Most Recent Groundwater Quality Laboratory Results (Shallow Wells)

Well Owner & Well ID	Sample Date	Lab[a]	EC (umhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (ug/L)	B (mg/L)	Mo (ug/L)	Se (ug/L)
Spreckels Sugar Co.										
MW-1	06/05/01	BSK	3800	2600	8.1	67.7	-	1.30	-	-
MW-2	06/05/01	BSK	2200	1400	7.0	8.3	-	0.40	-	-
MW-3	05/27/02	FGL	2510	1480	6.9	7.9	DQO	0.47	-	DQO
MW-4	06/05/01	BSK	1900	1200	6.8	12.0	-	0.20	-	-
MW-5	06/05/01	BSK	1700	1000	6.8	7.2	-	0.20	-	-
MW-6	06/05/01	BSK	1300	830	6.8	3.2	-	0.20	-	-
MW-9	06/05/01	BSK	840	580	6.4	1.1	-	<0.1	-	-
MW-13	06/05/01	BSK	2200	1700	7.3	7.8	-	0.20	-	-
MW-17	06/06/01	BSK	3600	2100	6.9	5.4	-	0.40	-	-
MW-18	06/06/01	BSK	6800	3700	7.4	21.9	-	0.40	-	-
MW-19	06/06/01	BSK	4200	2100	7.5	21.7	-	0.50	-	-
MW-20	06/06/01	BSK	2100	1400	7.3	10.0	-	0.40	-	-
MW-21	06/04/01	BSK	2100	1300	7.3	10.5	-	0.30	-	-
MW-23	06/04/01	BSK	4400	2400	7.4	18.6	-	0.40	-	-
MW-24	06/05/01	BSK	2400	1700	6.7	3.3	-	0.20	-	-
MW-25	06/06/01	BSK	2400	1500	7.7	21.5	-	0.50	-	-
MW-26	06/04/01	BSK	4900	2000	7.5	15.0	-	0.30	-	-
MW-27	06/06/01	BSK	7100	4100	7.4	20.8	-	0.30	-	-
MW-28	06/05/01	BSK	1800	1400	7.3	4.8	-	0.30	-	-
MW-29	06/05/01	BSK	1600	1200	6.7	2.1	-	0.10	-	-
MW-30	06/05/01	BSK	340	250	6.2	0.6	-	<0.1	-	-
MW-31	06/06/01	BSK	810	570	7.0	1.2	-	<0.1	-	-
MW-32	06/05/01	BSK	290	220	6.5	0.8	-	<0.1	-	-
Minimum detected value or detection limit			**290**	**220**	**6.2**	**0.6**	**NA**	**<0.1**	**NA**	**NA**
Maximum detected value			**7100**	**4100**	**8.1**	**67.7**	**NA**	**1.30**	**NA**	**NA**
Mean of detected values			**2617**	**1571**	**7.1**	**11.0**	**NA**	**0.35**	**NA**	**NA**
NORTH OF SAN JOAQUIN RIVER										
Newhall Land and Farming										
MW-2	06/11/02	JML	1090	-	7.1	4.0	-	0.17	-	-
MW-3	06/11/02	JML	320	-	7.3	3.1	-	0.15	-	-
MW-4	06/11/02	JML	1270	-	8.0	13.0	-	0.28	-	-
MW-5	06/11/02	JML	1060	-	7.5	5.3	-	0.25	-	-
Minimum detected value or detection limit			**320**	**-**	**7.1**	**3.1**	**-**	**0.15**	**-**	**-**
Maximum detected value			**1270**	**-**	**8.0**	**13.0**	**-**	**0.28**	**-**	**-**
Mean of detected values			**935**	**-**	**7.5**	**6.4**	**-**	**0.21**	**-**	**-**

[a] Laboratory Abbreviations: USGS - U.S. Geological Survey; FGL - Fruit Growers Laboratory, Santa Paula; BSK - BSK Analytical Laboratories, Fresno; TL - The Twining Laboratories, Inc.;
BCL - BC Laboratories, Bakersfield; CLS - California Laboratory Services, Rancho Cordova
OBL-Olson Biochemistry Laboratories

[b] Formerly E-1

[c] Formerly E-2

DQO = Data quality objectives for this analysis were not met for this sample. Results are not included in the EIS evaluation of this parameter. Results are reported in Appendix C.

NA = Not applicable

Table 3-8. Most Recent Groundwater Quality Laboratory Results (Deep Wells)

Well Owner & Well ID	Sample Date	Lab[a]	EC (umhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (ug/L)	B (mg/L)	Mo (ug/L)	Se (ug/L)
SAN JOAQUIN RIVER ARM										
MPG Production Wells										
Baker Farming Co.										
BF-1	06/26/02	FGL	555	380	8.7	15.9	<2	0.18	-	-
BF-1	06/26/02	OBL	-	-	-	-	-	-	5.9	<0.4
BF-2	06/26/02	FGL	496	310	8.6	12.5	<2	0.09	-	-
BF-2	06/26/02	OBL	-	-	-	-	-	-	3.1	<0.4
BF-3	10/01/01	FGL	511	310	8.8	11.7	<2	0.09	-	-
BF-3	10/01/01	OBL	-	-	-	-	-	-	3.5	<0.4
BF-4	10/02/01	FGL	539	310	8.8	13.3	<2	0.09	-	-
BF-4	10/02/01	OBL	-	-	-	-	-	-	3.0	<0.4
BF-5	10/01/01	FGL	462	300	8.5	6.0	<2	0.11	-	-
BF-5	10/01/01	OBL	-	-	-	-	-	-	3.8	<0.4
Farmers Water District										
R-1	06/25/01	FGL	-	-	-	-	<2	-	-	-
R-1	08/20/02	FGL	436	290	8.8	13.7		0.09	-	-
R-1	08/20/02	OBL	-	-	-	-	-	-	5.8	<0.4
R-2	10/02/01	FGL	-	-	-	-	<2	-	-	-
R-2	10/02/01	OBL	-	-	-	-	-	-	2.0	<0.4
R-2	06/17/02	TL	540	330	8.4	28.2	-	0.07	-	-
R-3	06/25/02	FGL	-	-	-	-	<2	-	-	-
R-3	06/25/02	OBL	-	-	-	-	-	-	<1.0	<0.4
R-3	08/20/02	FGL	778	520	7.9	11.5	-	0.08	-	-
R-4	10/01/01	FGL	-	-	-	-	3	-	-	-
R-4	10/01/01	OBL	-	-	-	-	-	-	3.1	<0.4
R-4	06/17/02	TL	240	150	8.7	13.6	-	<0.05	-	-
R-6	10/01/01	FGL	-	-	-	-	<2	-	-	-
R-6	10/01/01	OBL	-	-	-	-	-	-	6.1	<0.4
R-6	06/17/02	TL	480	290	8.2	6.3	-	0.07	-	-
R-7	10/01/01	FGL	-	-	-	-	<2	-	-	-
R-7	10/01/01	OBL	-	-	-	-	-	-	1.8	<0.4
R-7	06/17/02	TL	470	280	8.4	9.0	-	0.05	-	-
R-8	10/02/01	FGL	-	-	-	-	<2	-	-	-
R-8	08/20/02	FGL	616	420	8.7	18.3		0.24	-	-
R-8	08/20/02	OBL	-	-	-	-	-	-	8.7	<0.4
R-9	06/17/02	TL	710	440	8.4	23.1	-	0.31	-	-
R-10	10/02/01	FGL	-	-	-	-	<2	-	-	-
R-10	10/02/01	OBL	-	-	-	-	-	-	15.5	<0.4
R-10	06/17/02	TL	800	490	8.4	28.3	-	0.46	-	-
R-11	06/25/02	FGL	-	-	-	-	<2	-	-	-
R-11	06/25/02	OBL	-	-	-	-	-	-	9.3	<0.4
R-11	08/20/02	FGL	535	370	8.7	-		0.25		

Table 3-8. Most Recent Groundwater Quality Laboratory Results (Deep Wells)

Well Owner & Well ID	Sample Date	Lab[a]	EC (umhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (ug/L)	B (mg/L)	Mo (ug/L)	Se (ug/L)
Panoche Creek Farms										
PCF-1	06/26/02	FGL	575	390	8.6	13.0	<2	0.19	-	-
PCF-1	06/26/02	OBL	-	-	-	-	-	-	4.8	<0.4
Minimum detected value or detection limit			**240**	**150**	**7.9**	**6.0**	**<2**	**0.05**	**1.8**	**<0.4**
Maximum detected value			**800**	**520**	**8.8**	**28.3**	**3.0**	**0.46**	**15.5**	**NA**
Mean of detected values			**546**	**349**	**8.5**	**15.0**	**3.0**	**0.16**	**5.5**	**NA**
NORTHERN FRESNO SLOUGH										
MPG Production Wells										
Fordel, Inc.										
M-1	06/28/01	FGL	-	-	8.3	22.2	<2	0.56	9.0	-
M-1	10/01/01	FGL	1200	730	-	-	-	-	-	-
M-1	10/01/01	OBL	-	-	-	-	-	-	-	<0.4
Coelho/Coelho										
Conejo West	09/28/99	FGL	-	870	8.3	24.8	<2	0.70	-	DQO
Conejo West	07/13/00	FGL	1550	-	-	-	-	-	-	-
Coelho/Coehlho/Fordel										
CCF-1	06/26/01	FGL	-	-	8.2	25.5	<2	0.62	8.0	-
CCF-1	10/02/01	FGL	1740	1040	-	-	-	-	-	-
CCF-1	10/02/01	OBL	-	-	-	-	-	-	-	<0.4
Terra Linda Farms										
TL-1	06/25/02	FGL	1450	880	8.1	19.4	<2	0.41	-	-
TL-1	06/25/02	OBL	-	-	-	-	-	-	3.5	<0.4
TL-2	07/13/00	FGL	1440	-	-	-	-	-	-	-
TL-3	10/01/01	FGL	733	450	8.4	15.6	<2	0.35	-	-
TL-3	10/01/01	OBL	-	-	-	-	-	-	5.5	<0.4
TL-7	06/26/02	FGL	1250	760	8.4	24.2	<2	0.47	-	-
TL-7	06/26/02	OBL	-	-	-	-	-	-	7.3	<0.4
TL-8	06/25/02	FGL	1250	780	8.3	24.4	<2	0.51	-	-
TL-8	06/25/02	OBL	-	-	-	-	-	-	7.7	<0.4
TL-9	09/22/99	FGL	1387	-	-	-	-	-	-	-
Minimum detected value or detection limit			**733**	**450**	**8.1**	**15.6**	**<2**	**0.35**	**3.5**	**<0.4**
Maximum detected value			**1740**	**1040**	**8.4**	**25.5**	**NA**	**0.70**	**9.0**	**NA**
Mean of detected values			**1333**	**787**	**8.3**	**22.3**	**NA**	**0.52**	**6.8**	**NA**
CENTRAL FRESNO SLOUGH										
MPG Production Wells										
Terra Linda Farms										
TL-5	06/26/01	FGL	1530	900	8.3	29.4	<2	0.55	9.0	-
TL-5	06/26/01	OBL	-	-	-	-	-	-	-	<0.4
TL-6	09/22/99	FGL	4040	-	-	-	-	-	-	-
Fordel, Inc.										
Fordel/Bio	07/13/00	FGL	1350	-	-	-	-	-	-	-

Table 3-8. Most Recent Groundwater Quality Laboratory Results (Deep Wells)

Well Owner & Well ID	Sample Date	Lab[a]	EC (umhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (ug/L)	B (mg/L)	Mo (ug/L)	Se (ug/L)
Silver Creek Packing Co.										
SC-5	06/27/01	FGL	3970	2140	8.0	24.3	<2	1.11	7.0	-
SC-5	06/27/01	OBL	-	-	-	-	-	-	-	<0.4
SC-6	06/26/01	FGL	2770	1560	8.0	27.7	<2	0.72	5.0	-
SC-6	06/26/01	OBL	-	-	-	-	-	-	-	<0.4
Coelho/Gardner/Hanson										
CGH-7	07/13/00	FGL	1710	-	-	-	-	-	-	-
Meyers Farming										
MS-5	06/27/02	FGL	-	-	8.4	22.0	<2	0.84	-	-
MS-5	06/27/02	OBL	-	-	-	-	-	-	16.6	<0.4
MS-5	08/20/02	FGL	3190	1890	-	-	-	-	-	-
Other Wells										
AES Mendota										
No. 6	06/13/02	FGL	1430	-	8.4	-	-	-	-	-
Minimum detected value or detection limit			**1350**	**900**	**8.0**	**22.0**	**<2**	**0.55**	**5.0**	**<0.4**
Maximum detected value			**4040**	**2140**	**8.4**	**29.4**	**NA**	**1.11**	**16.6**	**NA**
Mean of detected values			**2499**	**1623**	**8.2**	**25.9**	**NA**	**0.81**	**9.4**	**NA**
NORTH OF MENDOTA										
CCID										
5A	06/07/01	BSK	730	460	7.9	7.5	-	0.20	-	-
12C	06/07/01	CCID	1700	1200	7.3	5.7	-	0.50	-	-
15B	06/21/01	CCID	1100	730	7.3	4.0	-	0.30	-	-
16B	10/20/93	NA	839	523	6.8	3.1	-	-	-	-
23B	06/07/01	CCID	2600	1100	7.5	7.4	-	1.20	-	-
28B	09/29/99	FGL	1410	960	6.7	3.6	<2	0.40	-	DQO
32B	06/07/01	BSK	2100	1600	7.8	5.5	-	1.40	-	-
35A	06/07/01	CCID	1200	830	7.6	4.2	-	0.30	-	-
38A	06/15/01	CCID	620	340	7.9	14.9	-	0.10	-	-
Locke Ranch										
No. 8	09/29/99	FGL	633	420	8.3	10.4	<2	0.20	-	DQO
City of Mendota										
No. 2	02/25/98	BCL	1340	830	7.8	6.9	<10	0.44	-	DQO
No. 3	10/02/01	FGL	2660	1680	7.9	13.0	<2	1.36	-	-
No. 3	10/02/01	OBL	-	-	-	-	-	-	10.1	<0.4
No. 4	06/27/01	FGL	2890	1790	7.8	12.4	<2	1.30	8.0	-
No. 4	06/27/01	OBL	-	-	-	-	-	-	-	<0.4
No. 5	10/02/01	FGL	2180	1400	7.9	11.5	<2	1.21	-	-
No. 5	10/02/01	OBL	-	-	-	-	-	-	8.9	<0.4
No. 6	01/23/96	NA	630	350	7.4	2.2	<2	-	-	DQO
Minimum detected value or detection limit			**620**	**340**	**6.7**	**2.2**	**<2**	**0.10**	**8.0**	**<0.4**
Maximum detected value			**2890**	**1790**	**8.3**	**14.9**	**NA**	**1.40**	**10.1**	**NA**
Mean of detected values			**1509**	**948**	**7.6**	**7.5**	**NA**	**0.69**	**9.0**	**NA**

Table 3-8. Most Recent Groundwater Quality Laboratory Results (Deep Wells)

Well Owner & Well ID	Sample Date	Lab[a]	EC (umhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (ug/L)	B (mg/L)	Mo (ug/L)	Se (ug/L)
WEST OF FRESNO SLOUGH										
USGS										
31J5	06/26/02	FGL	10100	7100	7.2	21.6	<2	3.15	-	-
31J5	06/26/02	OBL	-	-	-	-	-	-	18.2	<0.4
10A4	09/28/99	FGL	2820	2370	7.5	2.5	2	2.10	-	DQO
Hansen Farms										
7C1	06/27/01	FGL	-	-	7.8	20.9	5	4.98	37.0	-
7C1	10/03/01	FGL	9430	6300	-	-	-	-	-	-
7C1	10/03/01	OBL	-	-	-	-	-	-	-	65.6
Minimum detected value or detection limit			**2820**	**2370**	**7.2**	**2.5**	**2.0**	**2.1**	**18.2**	**<0.4**
Maximum detected value			**10100**	**7100**	**7.8**	**21.6**	**5.0**	**5.0**	**37.0**	**65.6**
Mean of detected values			**7450**	**5257**	**7.5**	**15.0**	**3.5**	**3.4**	**27.6**	**65.6**
EAST OF FRESNO SLOUGH										
City of Mendota										
No. 7	06/12/01	NA	732	468	8.3	27.2	5.8	0.61	-	DQO
No. 8	06/12/01	NA	564	401	8.5	17.2	3.5	0.46	-	DQO
No. 9	08/27/01	NA	598	420	8.3	22.7	2.7	0.48	-	DQO
B&B Ranch										
Mowry Die.	05/17/01	JML	630	-	8.1	29.8	-	0.47	-	-
Mowry Riv.	05/17/01	JML	480	-	7.8	4.3	-	0.10	-	-
Spreckels Sugar Co.										
MW-7	06/05/01	BSK	6500	4500	6.6	23.3	-	0.20	-	-
MW-8	06/05/01	BSK	1300	810	7.8	14.2	-	<0.1	-	-
MW-10	06/05/01	BSK	1200	740	7.8	13.1	-	<0.1	-	-
MW-11	06/05/01	BSK	1700	1100	7.4	15.8	-	0.20	-	-
MW-12	06/05/01	BSK	4700	2800	7.4	21.7	-	0.30	-	-
MW-14	06/06/01	BSK	1600	980	7.4	6.1	-	0.20	-	-
MW-15	06/06/01	BSK	6400	3500	7.6	26.4	-	0.40	-	-
MW-16	06/06/01	BSK	6200	3400	7.2	23.0	-	0.40	-	-
MW-22	06/06/01	BSK	2000	1200	7.4	22.3	-	0.20	-	-
Minimum detected value or detection limit			**480**	**401**	**6.6**	**4.3**	-	**<0.1**	-	**<0.4**
Maximum detected value			**6500**	**4500**	**8.5**	**29.8**	-	**0.61**	-	**NA**
Mean of detected values			**2472**	**1693**	**7.7**	**19.1**	-	**0.34**	-	**NA**
NORTH OF SAN JOAQUIN RIVER										
Columbia Canal Company										
Elrod-1	05/14/01	OBL	-	-	-	-	-	-	-	<0.4
Elrod -2	02/24/99	JML	400	-	7.8	21.2	-	0.26	-	-
Elrod-2	05/14/01	OBL	-	-	-	-	-	-	-	<0.4
N.F. Davis	02/24/99	JML	840	-	7.6	9.6	-	0.50	-	-
Cardella #1	05/04/01	JML	750	480	7.7	7.3	-	0.10	-	-
Cardella #2	05/04/01	JML	510	326	8.1	5.7	-	0.30	-	-
Cardella #2	05/04/01	OBL	-	-	-	-	-	-	-	<0.4

Table 3-8. Most Recent Groundwater Quality Laboratory Results (Deep Wells)

Well Owner & Well ID	Sample Date	Lab[a]	EC (umhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (ug/L)	B (mg/L)	Mo (ug/L)	Se (ug/L)
Lopes-1	05/04/01	JML	510	326	8.1	5.7	-	0.30	-	-
Lopes-1	05/14/01	OBL	-	-	-	-	-	-	-	<0.4
CC-1	05/04/01	JML	270	173	8.6	3.4	-	0.04	-	-
CC-2	05/04/01	JML	350	224	8.6	4.3	-	0.06	-	-
CC-2	05/04/01	OBL	-	-	-	-	-	-	-	<0.4
DMA	06/04/99	JML	1740	-	7.2	9.4	-	0.37	-	-
Snyder	05/04/01	JML	950	608	7.9	9.0	-	0.52	-	-
Newhall Land and Farming										
MW-1	06/11/02	JML	670	-	7.4	2.8	-	0.18	-	-
No. 32	09/14/01	JML	1210	-	7.3	4.8	-	0.22	-	-
No. 32	09/14/01	OBL								0.7
No. 42	09/14/01	JML	1130	-	7.5	9.3	-	0.42	-	-
No. 42	09/14/01	OBL	-	-	-	-	-	-	-	<0.4
No. 53	09/14/01	JML	580	-	8.1	5.5	-	0.07	-	-
No. 53	09/14/01	OBL	-	-	-	-	-	-	-	<0.4
No. 74	09/14/01	JML	940	-	7.8	21.3	-	0.60	-	-
No. 74	09/14/01	OBL	-	-	-	-	-	0.10	-	<0.4
No. 78	09/14/01	JML	430	-	8.3	29.2	-	0.10	-	-
No. 78	09/14/01	OBL	-	-	-	-	-	-	-	<0.4
No. 89	09/14/01	JML	1050	-	7.4	5.9	-	0.16	-	-
No. 89	09/14/01	OBL	-	-	-	-	-	-	-	0.9
No. 91	09/14/01	JML	1020	-	7.7	6.1	-	0.19	-	-
No. 91	09/14/01	OBL	-	-	-	-	-	-	-	<0.4
No. 94	09/14/01	JML	380	-	8.5	24.3	-	0.14	-	-
No. 94	09/14/01	OBL	-	-	-	-	-	-	-	<0.4
No. 95	09/14/01	JML	250	-	8.6	25.0	-	0.06	-	-
No. 95	09/14/01	OBL	-	-	-	-	-	-	-	<0.4
Minimum detected value or detection limit			**250**	**173**	**7.2**	**2.8**	**NA**	**0.04**	**NA**	**<0.4**
Maximum detected value			**1740**	**608**	**8.6**	**29.2**	**NA**	**0.60**	**NA**	**0.9**
Mean of detected values			**736**	**356**	**7.9**	**11.0**	**NA**	**0.23**	**NA**	**0.8**

[a] Laboratory Abbreviations: USGS - U.S. Geological Survey; FGL - Fruit Growers Laboratory, Santa Paula;
OBL - Olson Biochemistry Laboratories of South Dakota State University, Brookings, SD
BSK - BSK Analytical Laboratories, Fresno; TL - The Twining Laboratories, Inc., Fresno;
BCL - BC Laboratories, Bakersfield; JML - JM Lord, Fresno; AT - Agri Tech, Inc., Kerman; UAG - U.S. Agricultural Consultants and Laboratories, Burbank; CLS - California Laboratory Services, Rancho Cordova

NA = Not Available or Not Applicable; ND = Non Detect (detection limit unknown)

DQO = Data quality objectives for this analysis were not met for this sample. Results are not included in the EIS evaluation of this parameter. Results are reported in Appendix C.

Table 3-9. Results from Sediment Sampling Program

Sampling Station	Date	Replicate	Lab[a]	Arsenic (mg/kg)[b]	Boron (mg/kg)[b]	Molybdenum (mg/kg)[b]	Selenium (mg/kg)[b]	Electrical conductivity (μmhos/cm)	TOC (mg/kg)[b]	TOC (percent)	pH	CEC (meq/100g)	%Moisture	% Sand	% Silt	% Clay
San Joaquin River Arm																
Columbia Canal	08/22/2001	1	FGL	4	<12	<1.2	<1.2	485	3123	0.31	6.6	7.14	58.7	58.0	34.0	8.0
	08/22/2001	1	FGS				0.703									
	08/22/2001	2	FGL	7	<15	<1.5	<7.5	534	4136	0.41	6.6	14.90	66.8	30.0	56.0	14.0
	08/22/2001	3	FGL	6	<12	<1.2	<6.2	565	4454	0.45	6.8	10.60	59.5	44.0	46.4	9.6
	10/30/2001	1	CAS	3.5	5.05 J	<0.8	<1.1	201		0.66	8.17	27.7	34.9	64.0	26.8	9.2
	10/30/2001	2	CAS	2.8	6.52 J	0.8 J	<0.9	160		0.81	8.09	25.9	40.7	54.7	34.6	10.7
	10/30/2001	3	CAS	3.9	7.99 J	<0.7	<1.1	132		1.12	7.84	30.6	47.5	43.1	46.3	10.6
	10/15/2002	1	CAS	3.3	6.4 B	<0.6	<1	44		1.37	7.55	33.7	51.8	27.4	58.3	15.1
	10/15/2002	2	CAS	2.7	2.9 B	<0.6	<1	79		0.8	7.36	21.1	38.5	54.1	36.7	8.1
	10/15/2002	3	CAS	1.9 B	<2.3	0.7 B	<1.1	63		0.53	7.34	14.0	30.7	67.4	23.5	6.2
Northern Fresno Slough																
Mendota Dam	08/22/2001	1	FGL	10	20	<1.5	<7.4	1140	4024	0.40	7.0	20.50	66.2	10.0	72.4	17.6
	08/22/2001	2	FGL	9	20	<1.2	<5.9	1070	4596	0.46	7.4	17.40	57.6	28.0	54.4	17.6
	08/22/2001	2	FGS				0.72									
	08/22/2001	3	FGL	8	20	<1.2	<5.8	951	5126	0.51	7.0	15.60	57.2	38.0	46.4	15.6
	10/30/2001	1	CAS	6	18	1.0 J	<0.9	236		1.18	7.6	28.8	51.5	24.3	68.7	7.0
	10/30/2001	2	CAS	6.1	15.2	1.0 J	<1.0	211		0.92	7.52	35.5	47.9	26.7	64.3	9.0
	10/30/2001	3	CAS	5.6	12.1	<0.7	<1.0	246		0.92	7.47	37.6	47.7	24.3	66.2	9.5
	10/15/2002	1	CAS	4.6	11.8	<0.6	<1.1	130.0		0.92	7.39	35.6	40.9	29.4	60.5	10.5
	10/15/2002	2	CAS	4.6	11.2	0.8 B	<1.1	156.0		1.06	7.30	38.9	44.6	21.2	66.3	11.4
	10/15/2002	3	CAS	4.1	9.2 B	0.6 B	<0.9	106.0		1.03	7.56	40.0	45.5	35.8	53.3	12.1
Delta-Mendota Canal	08/22/2001	1	FGL	13	70	2	<6.1	1280	5032	0.50	7.8	42.0	59.3	10.4	34.0	55.6
	08/22/2001	1	FGS				2.94									
	08/22/2001	2	FGL	4.8	11	<0.86	<4.3	782	1127	0.11	7.7	7.98	41.7	78.4	12.0	9.6
	08/22/2001	3	FGL	4.8	11	<0.86	<0.86	506	810	0.08	7.8	7.56	41.6	78.0	14.0	8.0
	10/30/2001	1	CAS	8.8	40	1.5 J	<1.1	265		1.08	7.7	27.5	48.8	16.2	49.9	33.9
	10/30/2001	2	CAS	10.9	41.3	1.5 J	<1.0	314		0.69	7.67	20.3	55.4	7.5	44.0	48.5
	10/30/2001	3	CAS	10.8	52.8	1.8 J	<1.0	329		0.88	8.03	21.5	53.0	9.8	41.0	49.1
	10/15/2002	1	CAS	6.7	23.7	2.40	1.1 B	212		0.89	7.37	26.4	46.5	13.4	50.1	37.6
	10/15/2002	2	CAS	7.1	35.2	1.8 B	<1	178		0.64	7.50	35.0	44.6	18.7	14.0	30.3
	10/15/2002	3	CAS	6.8	35.5	1.7 B	1.1 B	223		0.83	7.51	24.6	51.0	10.3	35.0	42.0
Firebaugh Intake Canal	08/22/2001	1	FGL	10	20	<1.3	<6.4	701	4410	0.44	7.2	18.8	60.7	20.4	40.0	39.6
	08/22/2001	2	FGL	9	20	<1.2	<5.9	763	4008	0.40	7.4	13.9	57.4	32.4	52.0	15.6
	08/22/2001	3	FGL	10	20	1	<6.3	688	5536	0.55	7.3	16.3	60.6	28.4	53.0	18.6
	08/22/2001	3	FGS				0.864									
	10/30/2001	1	CAS	5.8	16.3	<0.7	<1.0	168		1.11	8.38	43.3	48.4	24.1	67.8	8.1
	10/30/2001	2	CAS	5.1	17.2	<0.8	<1.1	197		1.02	7.38	17.6	49.0	28.6	64.4	7.0
	10/30/2001	3	CAS	6.1	15.8	<0.7	<1.0	225		1.23	7.09	26.2	47.1	24.5	69.3	6.2
	10/15/2002	1	CAS	4.5	12.3	0.6 B	<0.9	66		1.38	7.17	35.4	48.1	17.0	70.0	12.1
	10/15/2002	2	CAS	4.7	12.2	0.9 B	<1	57		1.15	7.28	35.7	41.4	14.8	70.8	12.7
	10/15/2002	3	CAS	4.4	8.8 B	1.2 B	<0.9	89		1.23	7.33	41.1	46.4	21.1	66.9	12.1

Table 3-9. Results from Sediment Sampling Program

Sampling Station	Date	Replicate	Lab[a]	Arsenic (mg/kg)[b]	Boron (mg/kg)[b]	Molybdenum (mg/kg)[b]	Selenium (mg/kg)[b]	Electrical conductivity (µmhos/cm)	TOC (mg/kg)[b]	TOC (percent)	pH	CEC (meq/100g)	%Moisture	% Sand	% Silt	% Clay
Central Fresno Slough																
Etchegoinberry	08/22/2001	1	FGL	9	30	<2.1	<2.1	665	7978	0.80	7.3	30.40	75.8	18.4	40.0	41.6
	08/22/2001	1	FGS				1.58									
	08/22/2001	2	FGL	8	20	<1.8	<8.8	660	8464	0.85	7.3	27.70	71.6	16.4	46.0	37.6
	08/22/2001	3	FGL	7	<18	<1.8	<8.8	641	7837	0.78	7.3	26.40	71.7	14.4	48.0	37.6
	10/30/2001	1	CAS	6.9	27.4	<0.7	<1.0	144		1.76	7.65	35.9	73.6	0.5	58.2	41.3
	10/30/2001	2	CAS	5.8	27.2	1.0 J	<1.0	187		1.71	7.41	45.0	70.6	0.7	55.0	44.4
	10/30/2001	3	CAS	2.8	10.0 J	0.8 J	<1.0	182		0.72	7.84	19.2	36.0	66.8	27.1	6.1
	10/15/2002	1	CAS	5.0	20.6	0.9 B	<1.1	133		1.71	7.43	52.5	67.2	0.9	51.0	49.1
	10/15/2002	2	CAS	5.0	14.1	<0.6	<1.1	129		1.63	7.45	54.7	66.0	0.8	52.2	47.9
	10/15/2002	3	CAS	4.8	16.8	1 B	<1.1	112		1.73	7.60	57.1	69.8	1.1	54.3	48.5
Southern Fresno Slough																
Whitesbridge Road	08/22/2001	1	FGL	5	<22	<2.2	<2.2	909	5045	0.50	7.5	33.50	77.1	18.0	36.0	46.0
	08/22/2001	2	FGL	4	<20	<2	<2	951	7134	0.71	7.4	33.60	75.2	22.0	30.0	48.0
	08/22/2001	3	FGL	2.5	<9.5	<0.95	<0.95	443	1941	0.19	7.4	11.30	47.1	58.0	26.0	16.0
	08/22/2001	3	FGS				0.316									
	10/30/2001	1	CAS	4.5	31	<0.7	<1.0	205		1.47	7.37	46.5	71.4	2.4	49.5	48.1
	10/30/2001	2	CAS	4.5	29.7	1.3 J	<1.2	168		1.35	7.81	49.2	68.5	2.0	50.3	47.7
	10/30/2001	3	CAS	5.1	30.8	<0.7	<1.0	190		1.36	7.7	33.8	70.7	1.5	55.2	43.3
	10/15/2002	1	CAS	2.6 B	4.6 B	0.6 B	<1.1	168		0.20	7.60	13.4	25.7	74.6	19.1	3.8
	10/15/2002	2	CAS	3.20	4.2 B	0.7 B	<1	202		0.17	8.16	9.3	25.7	85.6	12.5	2.3
	10/15/2002	3	CAS	8.60	25.10	1.7 B	<1	162		0.32	8.30	34.8	38.0	53.7	24.3	16.2
James ID Booster Plant	08/22/2001	1	FGL	1.8	<8.4	<0.84	<4.2	570	1649	0.16	7.5	5.2	40.4	88.0	6.0	6.0
	08/22/2001	2	FGL	2.2	<8.1	<0.81	<4.1	526	874	0.09	7.5	3.9	38.4	90.0	5.0	5.0
	08/22/2001	3	FGL	1.7	<8.3	<0.83	<0.83	664	799	0.08	7.6	5.8	40.1	88.0	7.0	5.0
	08/22/2001	3	FGS				0.101									
	10/30/2001	1	CAS	2.7	10.2	<0.7	<1.0	255		0.84	7.8	39.7	47.3	30.1	58.7	11.2
	10/30/2001	2	CAS	2.3	6.6 J	<0.7	<1.0	265		0.54	7.5	24.4	42.1	53.0	37.4	9.5
	10/30/2001	3	CAS	2.9	9.7 J	<0.7	<1.0	298		1.00	7.6	16.9	47.9	35.1	53.6	11.3
	10/15/2002	1	CAS	2.5 B	6.3 B	<0.6	<1	112		0.73	7.8	22.2	40.9	37.6	58.4	9.7
	10/15/2002	2	CAS	2.60	10.80	1.1 B	<0.9	140		0.93	7.5	27.8	45.0	23.1	61.4	13.4
	10/15/2002	3	CAS	1.4 B	4.1 B	1.5 B	<1	170		0.42	8.1	11.9	28.8	73.3	20.0	6.1
Lateral 6	08/22/2001	1	FGL	10	60	<1	<10	1280	3402	0.34	8.0	43.8	51.1	14.4	34.0	51.6
	08/22/2001	1	FGS				0.485									
	08/22/2001	2	FGL	5	40	<1.1	<5.4	1260	5826	0.58	8.0	39.9	53.5	24.4	27.6	48.0
	08/22/2001	3	FGL	5.4	37	<0.97	<4.8	1160	6158	0.62	8.0	39.4	48.3	26.0	28.0	46.0
	10/30/2001	1	CAS	3.3	33	1.0 J	<1.1	305		0.99	8.1	19.6	59.2	2.4	74.5	23.1
	10/30/2001	2	CAS	3.4	28.9	<0.8	<1.1	277		0.96	8.0	33.7	59.4	9.5	67.8	22.7
	10/30/2001	3	CAS	3.7	28.0	<0.8	<1.1	247		0.99	8.1	25.0	58.1	11.6	64.8	23.6
	10/15/2002	1	CAS	3.2	17.2	1 B	<1.1	147		0.91	8.0	35.1	44.0	25.5	55.7	16.2
	10/15/2002	2	CAS	2.8	25.7	0.8 B	<1	147		1.02	8.2	42.6	49.7	18.3	61.9	21.1
	10/15/2002	3	CAS	2.6 B	28.1	<0.6	<1	271		1.08	7.8	40.8	51.7	5.3	72.9	21.9

[a] Laboratory abbreviations: FGL - Fruit Growers Laboratory, Santa Paula, California; FGS - Frontier Geosciences, Seattle, Washington; CAS - Columbia Analytical Services, Kelso, Washington
[b] Data are expressed on a dry weight basis
[c] J or B- Result is an estimated concentration that is greater than the Method Detection Limit but less than the Method Reporting Limit.

Table 3-10. Estimated Average Waterfowl Use-days for the Mendota Wildlife Area

Month	Waterfowl	Coot	Total (days)	Days in month	Use days per Month[1]
August	20,000	0	20,000	31	620,000
September	30,000	5,000	35,000	30	1,050,000
October	45,000	5,000	50,000	31	1,550,000
November	25,000	10,000	35,000	30	1,050,000
December	55,000	15,000	70,000	31	2,170,000
January	80,000	15,000	95,000	31	2,945,000
February	60,000	15,000	75,000	28	2,100,000
March	50,000	15,000	65,000	31	2,015,000
April	25,000	10,000	35,000	30	1,050,000
May	5,000	0	5,000	31	155,000
June	5,000	0	5,000	30	155,000
July	5,000	0	5,000	31	155,000
Total	405,000	90,000	495,000	365	15,015,000

[1]The average monthly use-days were approximated because the results were based on aerial census information that is primarily used for indexing waterfowl population trends.

Table 3-11. Fish Species Present During Qualitative Sampling in Mendota Pool (December 6, 2001).

Common Name	Species Name	Location	Notes
Threadfin Shad	*Dorosoma petenense*	CC, DMC, WBR	Abundant (>33%)
Hitch	*Lavinia exilicauda*	CC	Uncommon (1 fish)
Brown Bullhead	*Ictalurus nebulosus*	CC	Common, only 1 fish seined, but dominant catch of anglers in area
Inland Silverside	*Menidia beryllina*	CC, DMC, WBR	Abundant (10%)
Striped Bass	*Morone saxatilis*	WBR	Uncommon (< 1% of catch)
Bluegill	*Lepomis macrochirus*	CC, DMC, WBR	Abundant (>33%)
Green Sufish	*Lepomis cyanellus*	WBR	Uncommon (< 1% of catch)
Redear Sunfish	*Lepomis microlophus*	WBR	Common (< 10% of catch)
Warmouth	*Lepomis gulosus*	WBR	Uncommon (< 1% of catch)
Black Crappie	*Pomoxis nigromaculatus*	DMC, WBR	Common (< 5% of catch)
White Crappie	*Pomoxis annularis*	DMC, WBR	Common (< 5% of catch)
Largemouth Bass	*Micropterus salmoides*	DMC, WBR	Common (< 5% of catch)
Bigscale Logperch	*Percina macrolepida*	CC, DMC, WBR	Common (< 5% of catch)
Shimofuri Goby	*Tridentiger bifasciatus*	DMC, WBR	Uncommon (< 1% of catch)
Prickly Sculpin	*Cottus asper*	DMC	Uncommon (1 fish)

Table 3-12. Summary of Special Status Animal Species Within The Project Area

Species	Listing	Most Recent Sighting In Project Area Recorded In CNDDB	Habitat	Site Use	Breeding
WETLAND/AQUATIC ASSOCIATED SPECIES					
Agelaius tricolor - tricolored blackbird	SC	not listed	Seeks cover in emergent vegetation such as tules and cattails. Highly colonial. Nest area must be big enough for colony, near open water, and within 6.4 km from foraging area. Feed on insects, seeds, and cultivated grain.	Colonial Nest site	April to late June.
Clemmys marmorata - Western pond turtle	SC	not listed	Aquatic turtle that inhabits ponds, marshes, rivers, streams, and irrigation ditches that contain aquatic vegetation. Requires basking sites and sandy banks or grassy open fields for nesting.	NA	March to Aug.
Plegadis chihi - white-faced ibis	SC	6/15/1905	Fresh water marshes containing dense tule thickets for nesting interspersed with areas of shallow water for foraging.	Rookery site	Mating occurs from April to May. Laying occurs from May to June.
Thamnophis gigas - giant garter snake	ST, FT	5/26/1999	Aquatic snake that prefers freshwater marshes and low gradient streams. Forage and take cover in emergent vegetation. During dormant period takes shelter in small mammal burrows in upland habitat. Makes use of drainage canals and irrigation ditches.	NA	May - July peaking from May – June
Rana aurora draytonii – California red-legged frog	FT	not listed	Permanent sources of deep water with dense shrub or emergent vegetation. Require habitat under ground to remain dormant during the summer.		
Hypomesus transpacificus – delta smelt	FT	not listed	Euryhaline fish found in brackish water. Use the channels and deadened sloughs of the Delta for spawning.		
Pogonichtyhys macrolepidotus – Sacramento splittail	FT	not listed	Primarily a freshwater fish but are tolerant of moderate salinities. Have been found in slow-moving sections of rivers and sloughs.		
Oncorhynchus mykiss – Central Valley Steelhead	FT	not listed	Anadramous form of rainbow trout. They are born in freshwater emigrate to the ocean where most of their growth occurs, and return to freshwater to spawn.		

Table 3-12. Summary of Special Status Animal Species Within The Project Area

Species	Listing	Most Recent Sighting In Project Area Recorded In CNDDB	Habitat	Site Use	Breeding
Branchinecta lynchi – vernal pool fairy shrimp	FT	not listed	Found in vernal pools of various sizes and types. These can be shallow, short-lived and grassy to very large, deep and turbid.		
Lepidurus packardi – vernal pool tadpole shrimp	FE	not listed	Occupy a range of pool sizes and types. These can be very small, vegetated, clear water vernal pools to very large, turbid vernal lakes.		
Clemmys marmorata marmorata – northwestern pond turtle	SC	not listed	Associated with permanent or nearly permanent water like ponds, lakes, streams, irrigation ditches or permanent pools along intermittent streams in a wide variety of habitat types. Require basking sites such as partially submerged logs, rocks, mats of floating vegetation, or open mud banks.		
Spirinchus thaleichthys – longfin smelt	SC	not listed	Adults and juveniles occupy mostly the middle or bottom parts of the water column in the salt or brackish portions of the estuary, although larval smelt are concentrated in near-surface brackish waters.		
Branchinecta mesovallensis – Midvalley fairy shrimp	SC	not listed	Inhabits vernal pools and seasonal wetlands.		
Linderiella occidentalis – California linderiella fairy shrimp	SC	not listed	Inhabits vernal pools.		
Lytta molesta – molestan blister beetle	SC	not listed	Specimens of this species have been collected from vernal pool vegetation. Very little is known about their life cycle and other requirements.		
Rana boylii – foothill yellow-legged frog	SC	not listed	Found in or near rocky streams in a variety of habitats. Adults often bask on exposed rock surfaces near streams.		
Grus canadensis tabida – greater sandhill crane	CA	not listed	Occurs in and near wet meadow, shallow lacustrine, and fresh emergent wetland habitats during the summer. Prefers open habitats with shallow lakes and fresh emergent wetlands when nesting.		
Numenius americanus – long-billed curlew	SC	not listed	Inhabits large coastal estuaries, upland herbaceous areas, and croplands. At coastal estuaries, requires high salt marsh, pastures or salt ponds for roosting.		

Table 3-12. Summary of Special Status Animal Species Within The Project Area

Species	Listing	Most Recent Sighting In Project Area Recorded In CNDDB	Habitat	Site Use	Breeding
Branta canadensis leucopareia – Aleutian Canada goose	D	not listed	Preferred habitats include lacustrine, fresh emergent wetlands, and moist grasslands, croplands, pastures, and meadows. Prefers to nest near water and may nest in marshes on mats of bulrushes or muskrat houses.		
RIPARIAN SPECIES					
Buteo swainsoni - Swainson's hawk	ST	5/23/2000	Nest in Juniper-sage flats, riparian areas and in oak savannah habitat that contains few trees. Requires suitable foraging areas such as grasslands, alfalfa fields, or grain fields that support rodent populations.	Nest site. Not in area from Sept. to Feb.	March to August with peak from April to May
Coccyzus americanus occidentalis - Western yellow-billed cuckoo	SE - possibly extirpated	7/1950	Deciduous riparian thickets or forest with willow usually being the most dominant vegetation. Nest along lower flood-bottoms of larger river systems where humidity is high. Roost in dense deciduous trees and shrubs.	Nest site	March to Aug.
Riparia riparia –bank swallow	ST	8/17/1980	Use of vertical banks and cliffs with fine textured soil to excavate nesting hole. Nest primarily in riparian and other lowland habitats near streams, rivers, lakes, and ocean.	Nest site Arrive in March	NA
Haliaectus leucocephalus – bald eagle	FT	not listed	Requires large, old-growth trees or snags in remote, mixed stands near water. Nests are usually located near a permanent water source.		
Neotoma fuscipes riparia – riparian San Joaquin Valley) wood rat	FE	not listed	Prefers forest habitats with moderate canopy, year-round greenery, a brushy understory, and suitable nest building materials.		
Desmocerus californicus dimorphus – valley elderberry longhorn beetle	FT	not listed	Lives only in thickets of native elderberry that grows amidst other native plants along the valley's waterways.		
Melanerpes lewis – Lewis' woodpecker	SC	not listed	Suitable habitat includes open, deciduous and conifer habitats with brushy understory, and scattered snags and live trees for nesting and perching.		

Table 3-12. Summary of Special Status Animal Species Within The Project Area

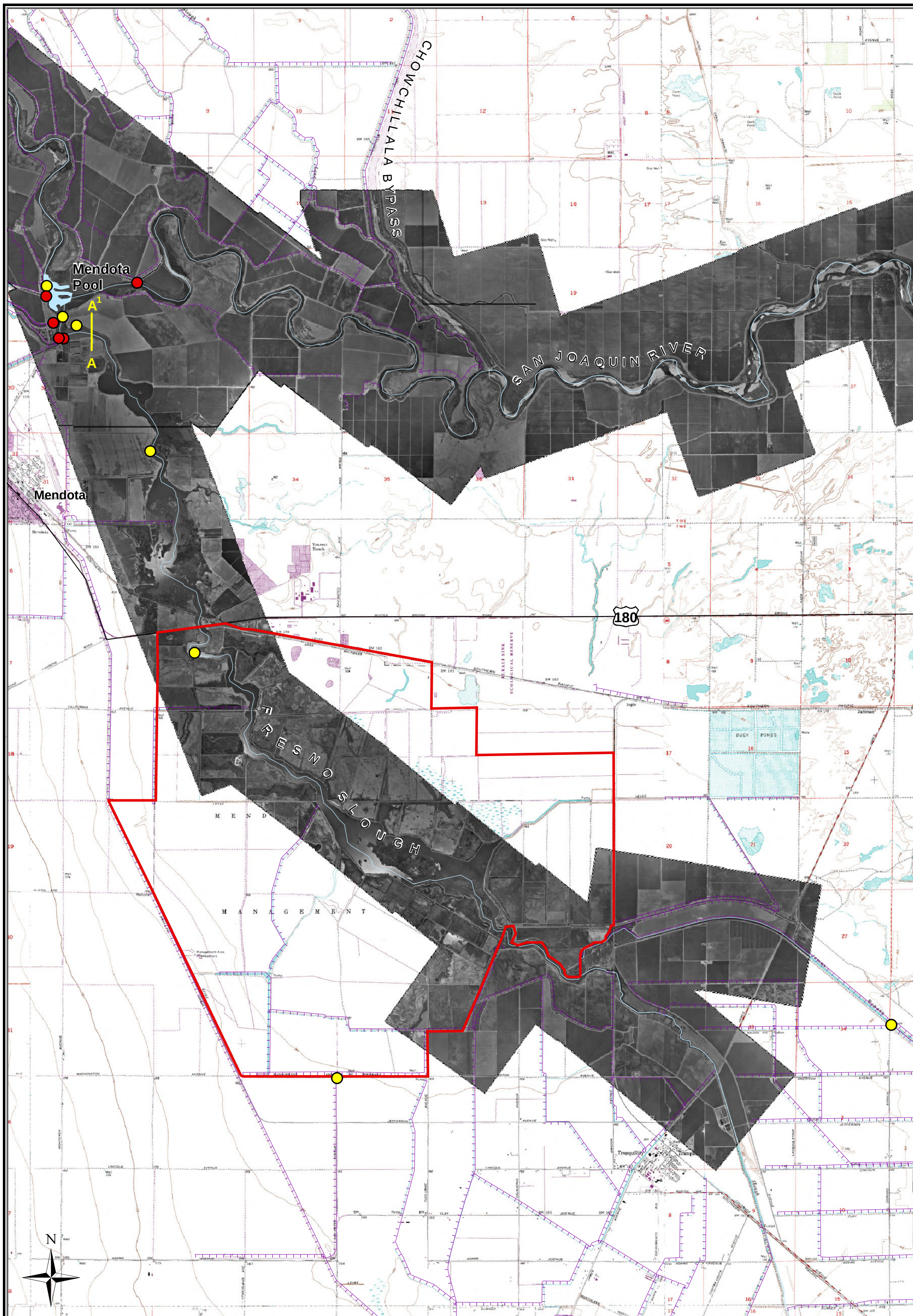
Species	Listing	Most Recent Sighting In Project Area Recorded In CNDDB	Habitat	Site Use	Breeding
Selasphorus rufus – rufous hummingbird	SC	not listed	Uses riparian areas, open woodlands, chaparral and other habitats rich in nectar-producing flowers.		
Elanus leucurus – white-tailed kite	SC	not listed	Resident of coastal and valley lowlands; rarely found away from agricultural areas. Substantial groves of dense, broad-leafed deciduous trees used for nesting and roosting.		
Empidonax traillii brewsteri – little willow flycatcher	CA	not listed	Most often occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows. Extensive thickets of low, dense willows edge on wet meadows, ponds, or backwaters required for nesting and roosting.		
Falco peregrinus anatum – American peregrine falcon	D	not listed	Inhabits riparian areas and coastal and inland wetlands year long, especially in non-breeding seasons. Usually breeds and feeds near water.		
Anniella pulchra pulchra – silvery legless lizard	SC	not listed	Found primarily in areas with sand or loose organic soils or where there is plenty of leaf litter. Often found where substrates are slightly moist.		
GRASSLAND SPECIES					
Athene cunicularia hypugaea - Western burrowing owl	SC	2/24/1993	Found in dry annual or perennial grasslands, desserts, and scrublands. Use burrows of small mammals especially the California ground squirrel.	Burrowing sites	March to August with peak from April to May
Dipodomys nitratoides exilis - Fresno kangaroo rat	SE, FE	11/11/1992	Grassland habitats containing bare alkaline clay-based soils subject to seasonal inundation, that also includes friable soils around mounds of shrubs and grasses. Found in Western Fresno County.	NA	December to September
Gambelia sila - blunt nosed leopard lizard	FE, SE	1981	Sparsely vegetated alkali and desert scrub habitats with low topographic relief. Uses small mammalian burrows.	NA	Mating occurs from April to May. Laying occurs from May to June.
Dipodomys ingens – giant kangaroo rat	FE	not listed	Requires fairly large areas of homogenous terrain, with only scattered shrubs, but with an open, herbaceous cover of annual forbs and grasses.		
Dipodomys nitratoides nitratoides – Tipton kangaroo rat	FE	not listed	Resident of alkali desert scrub habitat and herbaceous habitats with scattered shrubs. Uses nearly level terrain with sandy, loamy soils for		

Table 3-12. Summary of Special Status Animal Species Within The Project Area

Species	Listing	Most Recent Sighting In Project Area Recorded In CNDDB	Habitat	Site Use	Breeding
			excavation of burrows.		
Vulpes macrotis mutica – San Joaquin kit fox	FE	not listed	Lives in annual grasslands or grassy open stages of vegetation dominated by scattered brush, shrubs, and scrub. Cover provided by dens they dig in open, level areas with loose-textured, sandy and loamy soils.		
Buteo regalis – ferruginous hawk	SC	not listed	Frequents open grasslands, sagebrush flats, desert scrub, low foothills surrounding valleys, and fringes of pinyon-juniper habitats. Roosts in open areas.		
Scaphiopus hammondii – western spadefoot toad	SC	not listed	Mostly inhabits grasslands with shallow, temporary pools. Rarely found on the surface. Spends most of the year in underground burrows which they construct themselves. Some individuals also use mammal burrows.		
Myotis ciliolabrum – small-footed myotis bat	SC	not listed	Found in arid uplands. Prefers open stands in forests and woodlands as well as brushy habitats. Uses streams, ponds, springs and stock tanks for drinking and feeding.		
Ammospermophilus nelsoni – San Joaquin (=Nelson's) antelope squirrel	SC	not listed	Suitable habitat includes widely scattered shrubs, annual forbs and grasses and is distributed over broken terrain with small gullies and washes. They dig burrows or use kangaroo rat burrows.		

Table 3-13. Summary of Special Status Plant Species Within the Project Area

Species	Listing	Most Recent Sighting In Project Area Recorded In CNDDB	Habitat	Site Use	Breeding
WETLAND/AQUATIC ASSOCIATED PLANTS					
Sagittaria sanfordii – valley sagittaria (= Sanford's arrowhead)	SC	not listed	A freshwater marsh species which occurs in small ponds and sluggish waters of creeks, ditches and canals.		
Atriplex minuscula – lesser saltscale	SC	not listed	Grows on sandy soils in alkaline areas, often in association with slough systems and river floodplains. However, it is found only in microhabitats that are inundated year-round.		
Cordylanthus palmatus – palmate-bracted bird's beak	FE, SE	9/26/1996	Restricted to seasonally-flooded, saline-alkali soils in lowland plains and basins. Grows primarily along the edges of channels and drainages.	NA	mid-June to mid-July
Monolopia congdonii – San Joaquin woolly-threads	FE	not listed	Grows on sandy soils in alkali sinks.		
GRASSLAND SPECIES					
Atriplex depressa – brittlescale	SC	not listed	Grows on alkaline clay, often in association with vernal pools or within scrub or annual grasslands.		
Atriplex vallicola – Lost Hills crownscale	SC	not listed	Typically grows in the dried beds of alkaline pools within scrub or annual grassland communities.		
Delphinium recurvatum – recurved larkspar	SC	not listed	Grows on alkaline clay in low-lying scrublands and on hillsides in grasslands		
Cordylanthus mollis ssp. Hispidus – hispid bird's beak	SC	not listed	Grows in alkaline areas, often in association with grasslands.		
Layia munzii – Munz's tidy-tips	SC	not listed	Grows on alkaline clay in low-lying scrublands and on hillsides in grasslands.		
Atriplex cordulata – heartscale	SC	not listed	Grows in alkaline areas, often in association with scrublands and grasslands.		
Eriastrum hooveri – Hoover's eriastrum (=wooly-star)	FT	not listed	Found in the Central Valley of California in "Valley grassland" with saltbrush, annual grasses, and goldfields, in areas where there is sparse covering of annual grass.		



Surface Water Sampling Location

- Continuous EC Recorder
- Grab Sample Location
- **Mendota Wildlife Area**
- **Canal/Ditch**

1:70,000

1 0.5 0 1 2 Miles

NAD83 CA STATEPLANE FIPSZONE 403

Figure 3-1
Surface Water Sampling Locations

ENTRIX

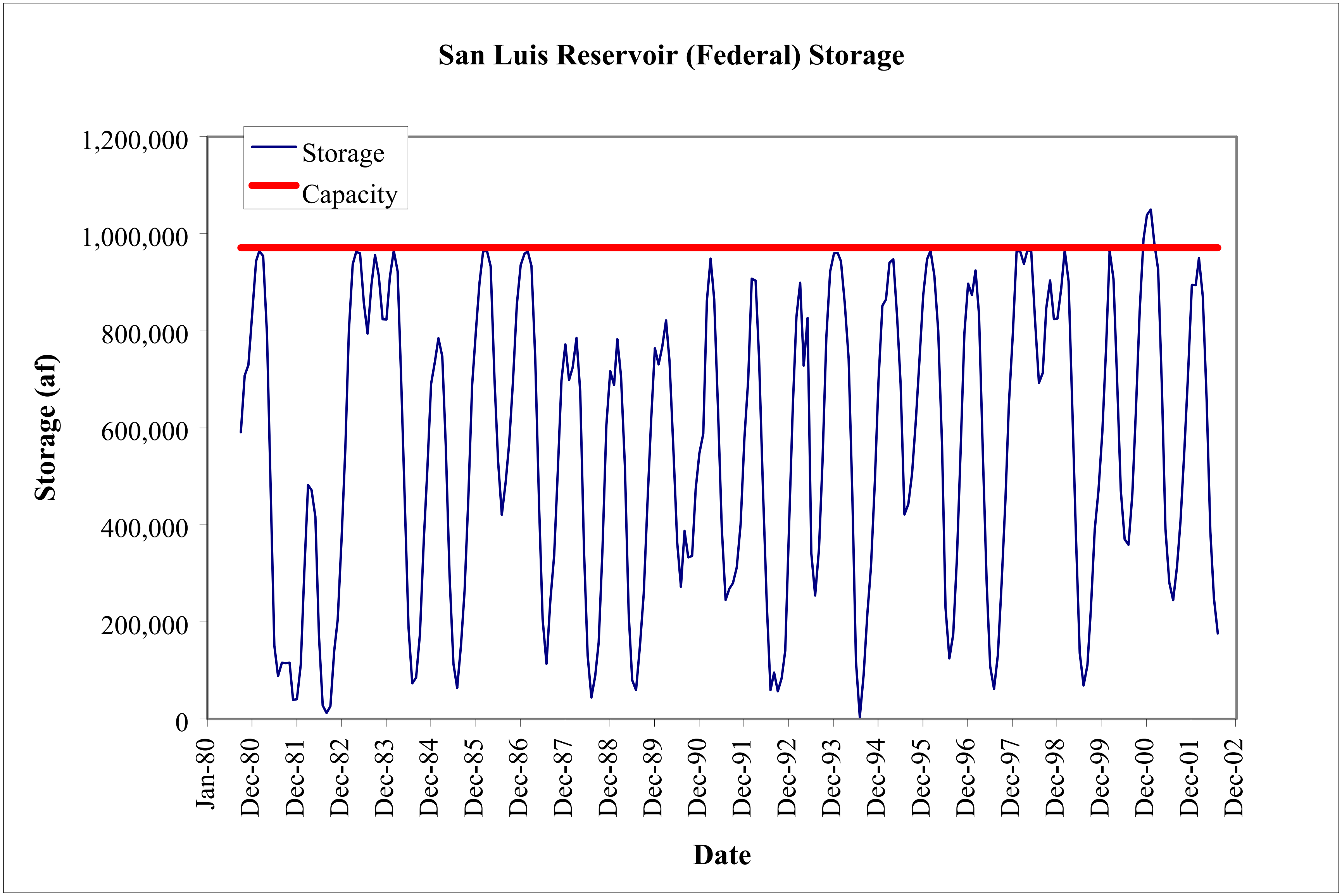


Figure 3-2. Federal Storage in San Luis Reservoir

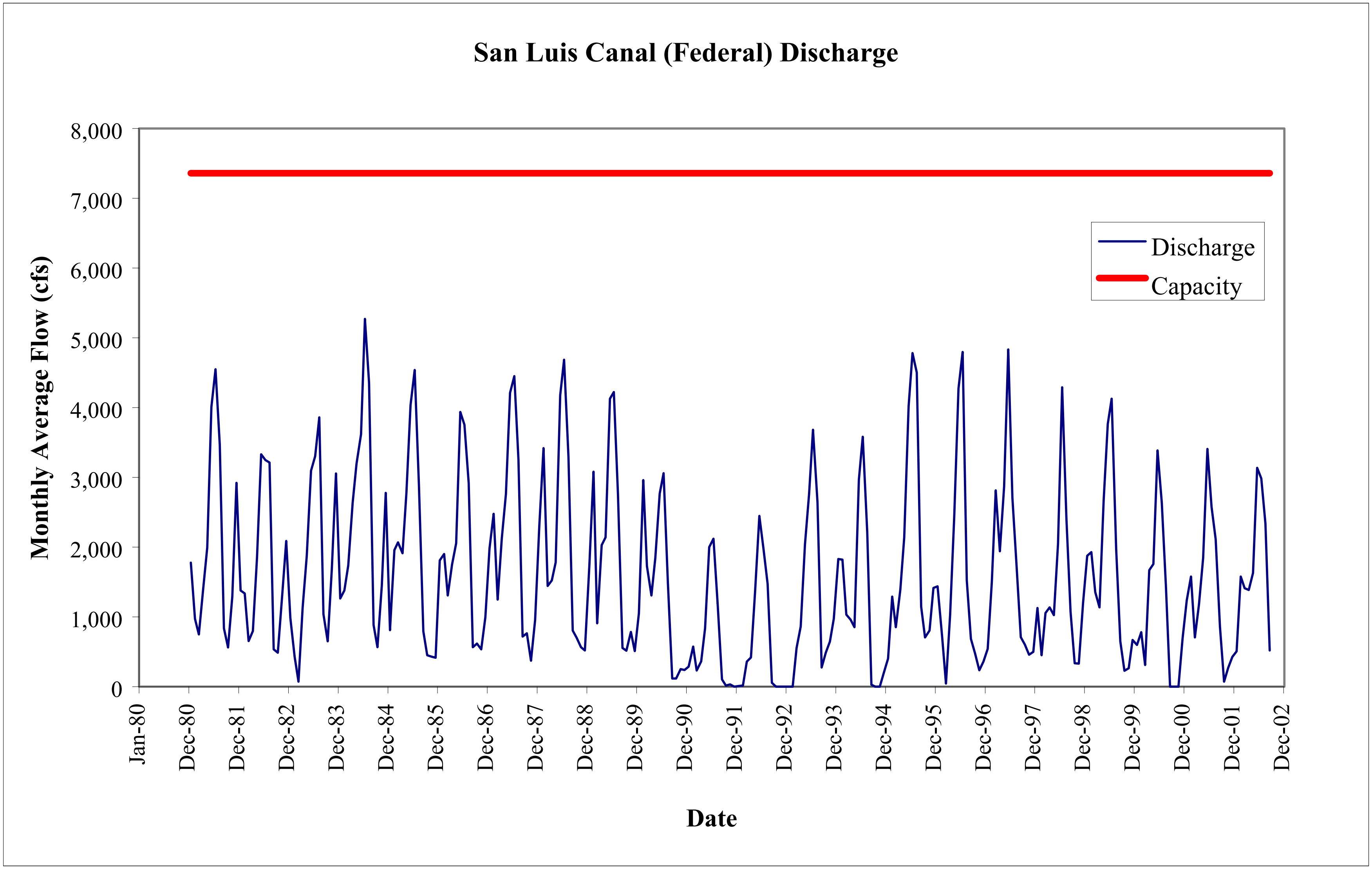


Figure 3-3. Federal Flows in San Luis Canal

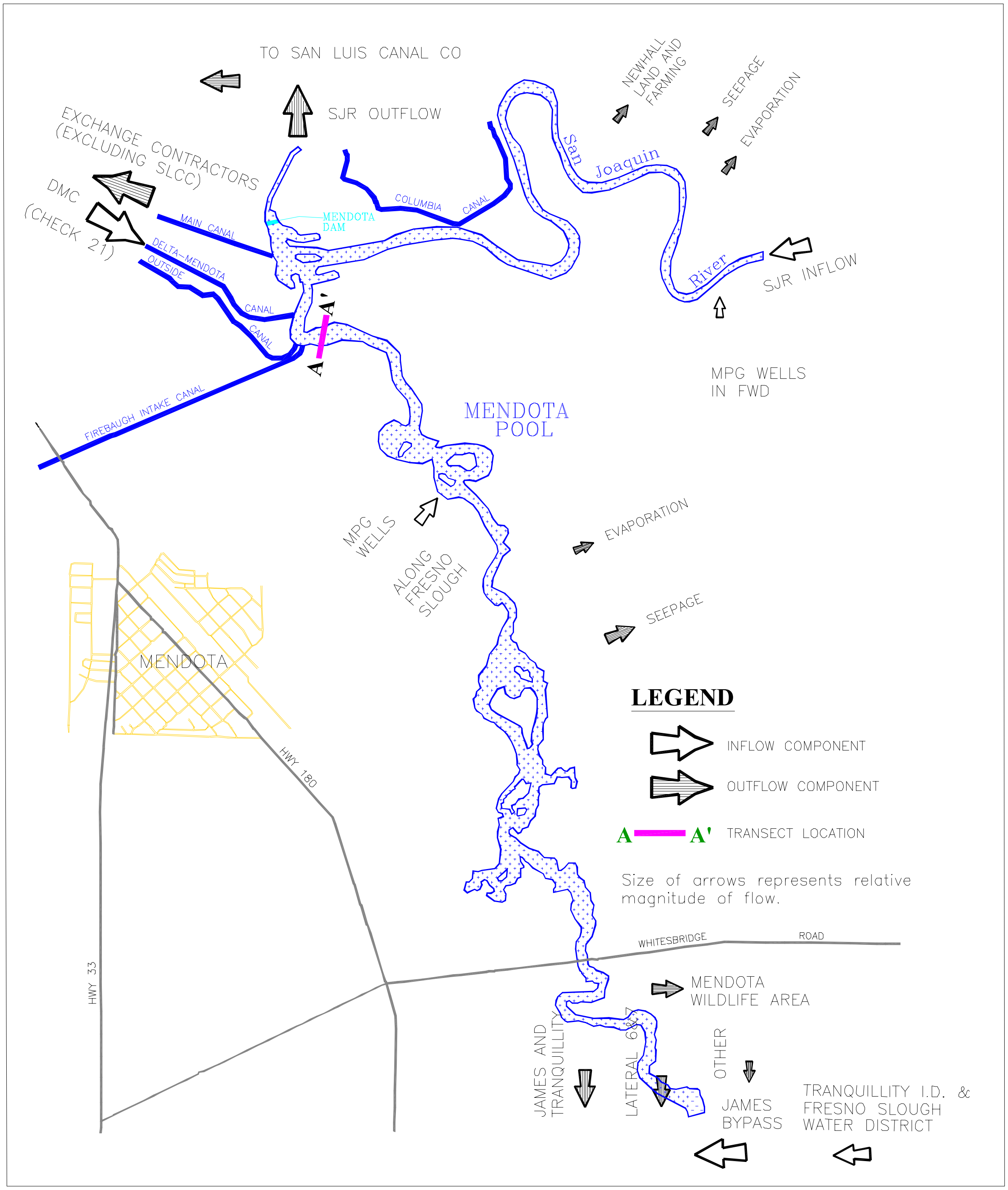


Figure 3-4 Inflow and Outflow Components for Mendota Pool Water Budget

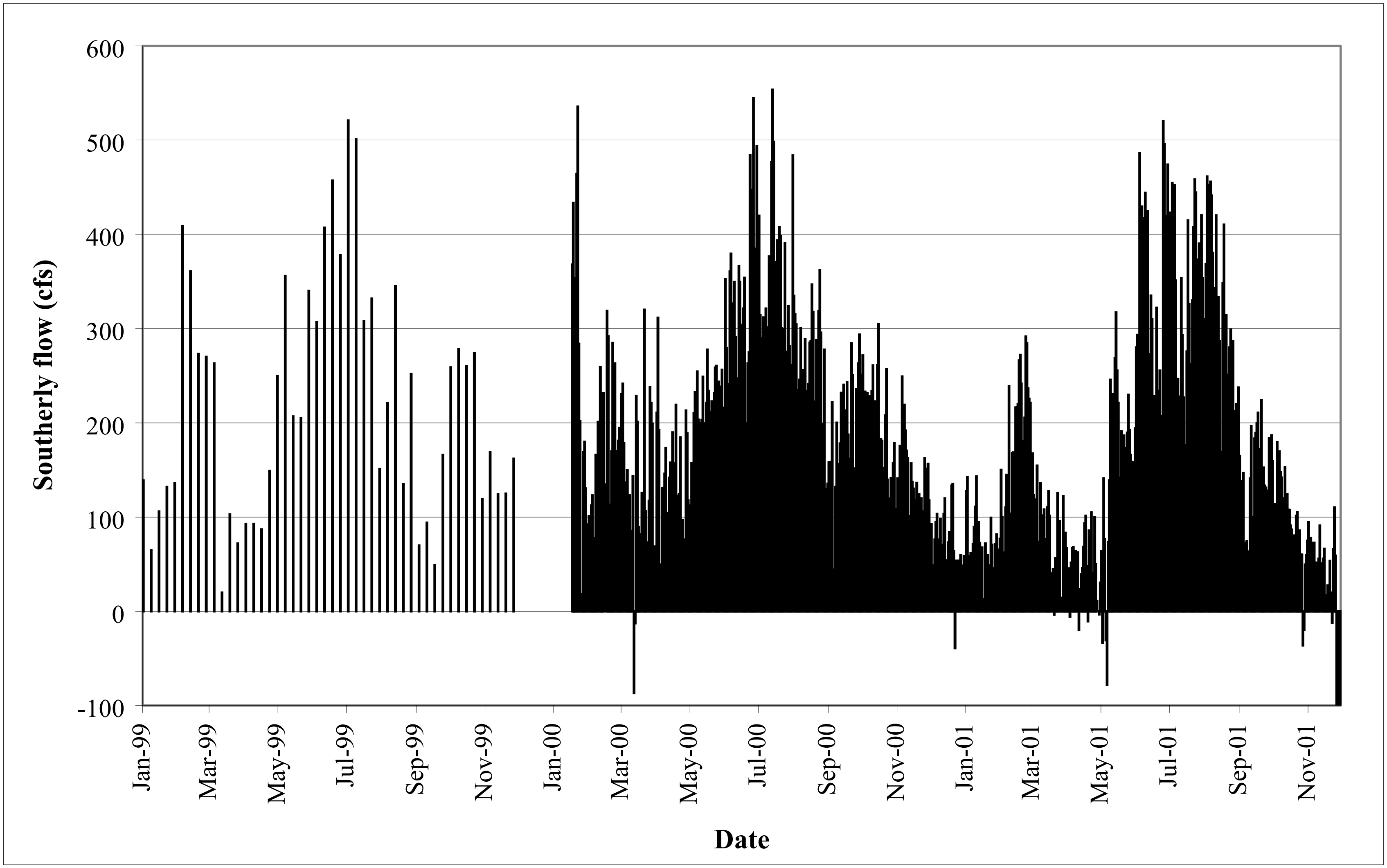
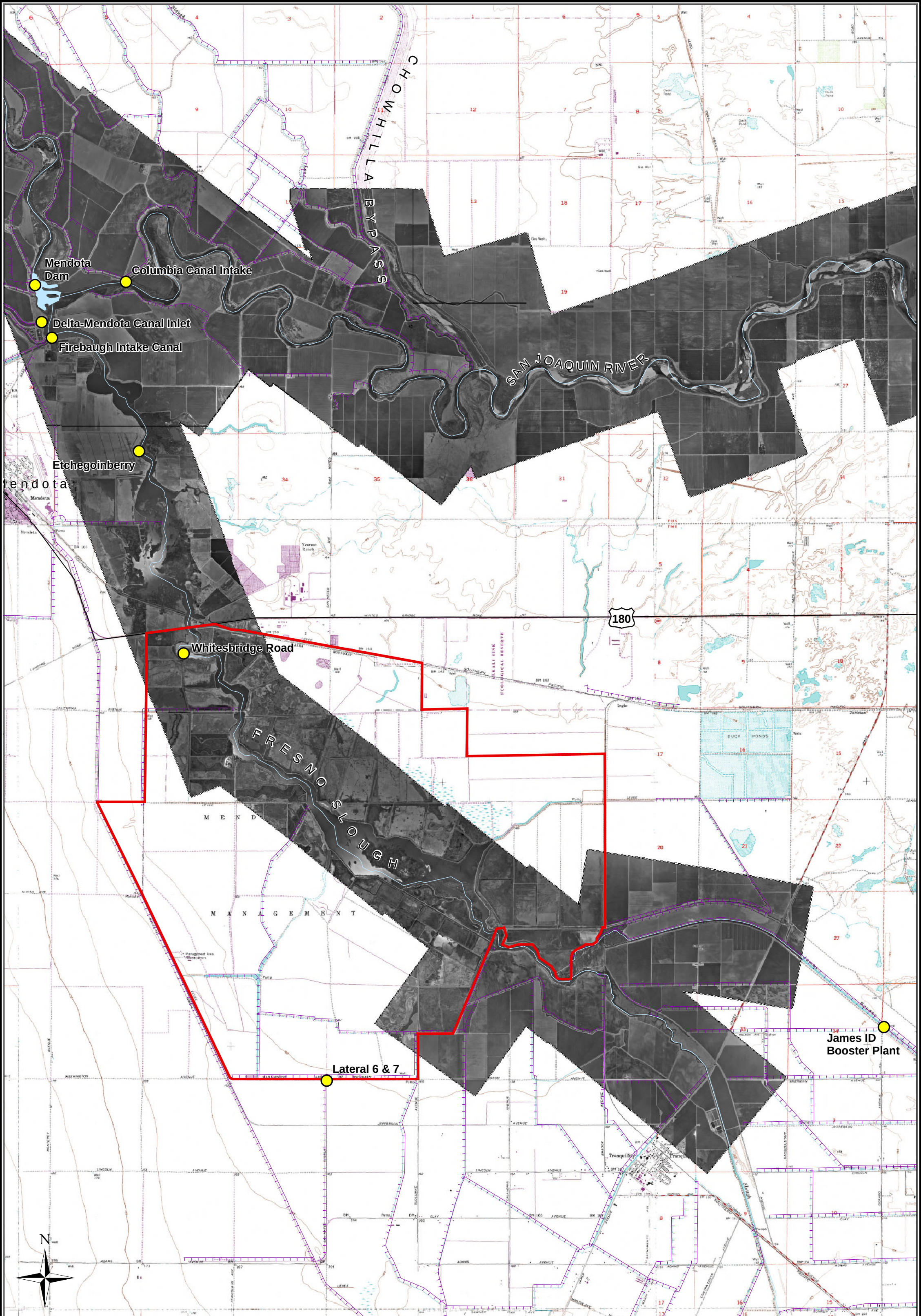


Figure 3-5. Net Southerly Flow Across Transect A-A′ Calculated From Daily Water Budgets. Negative Values Indicate Northerly Flow.



Sediment Sampling Location

- Sediment Sampling Location
- **Mendota Wildlife Area**
- **CANAL/DITCH**

1:70,000

1 0.5 0 1 2 Miles

NAD83 CA STATEPLANE FIPSZONE 403

Figure 3-6
Sediment Sampling Locations

ENTRIX

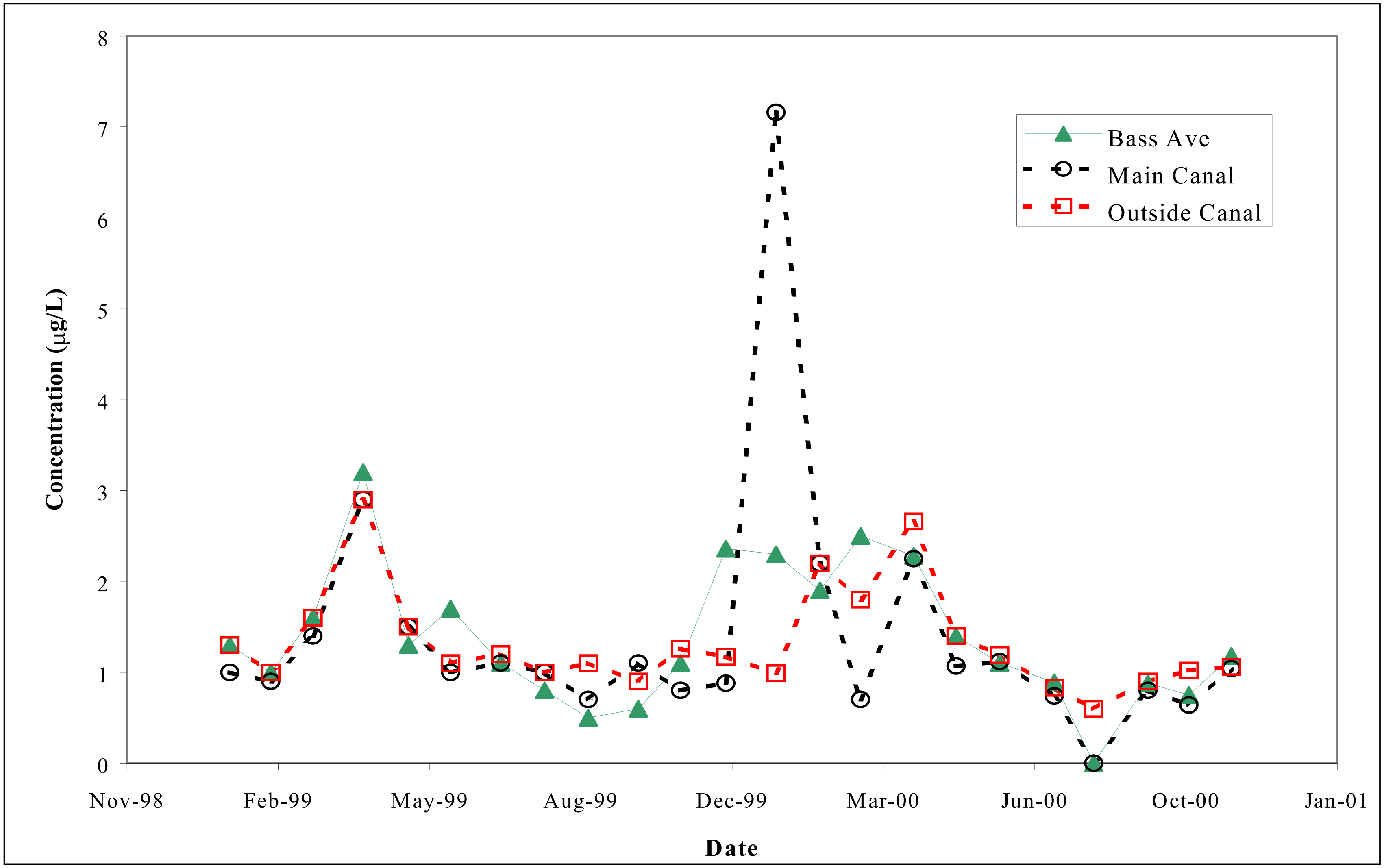


Figure 3-7. Selenium Concentrations at Terminus of DMC and at Canal Intakes

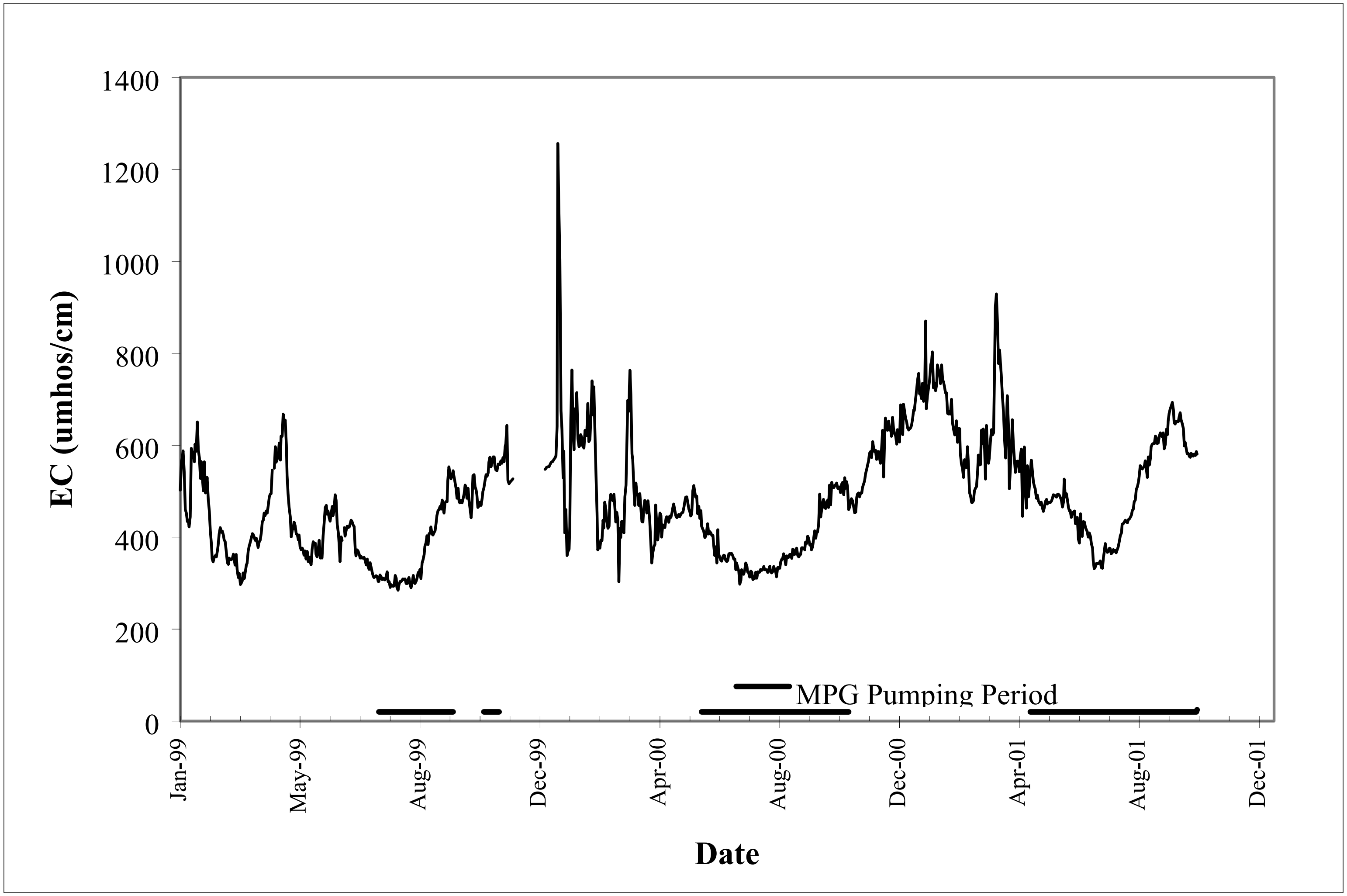


Figure 3-8. Daily Mean EC at DMC Terminus

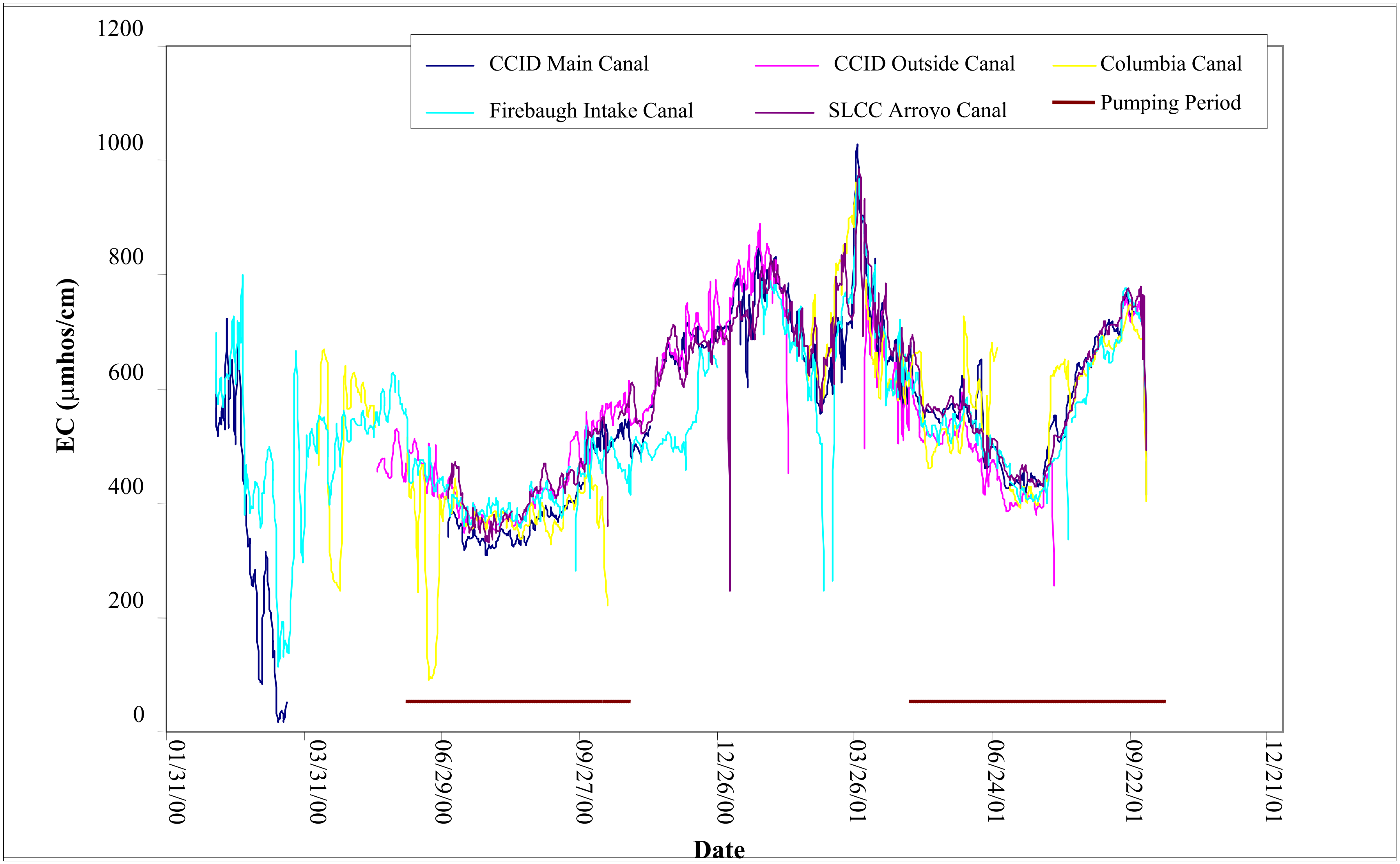


Figure 3-9. Daily Mean EC (µmhos/cm @ 25^0C) at Canal Intakes

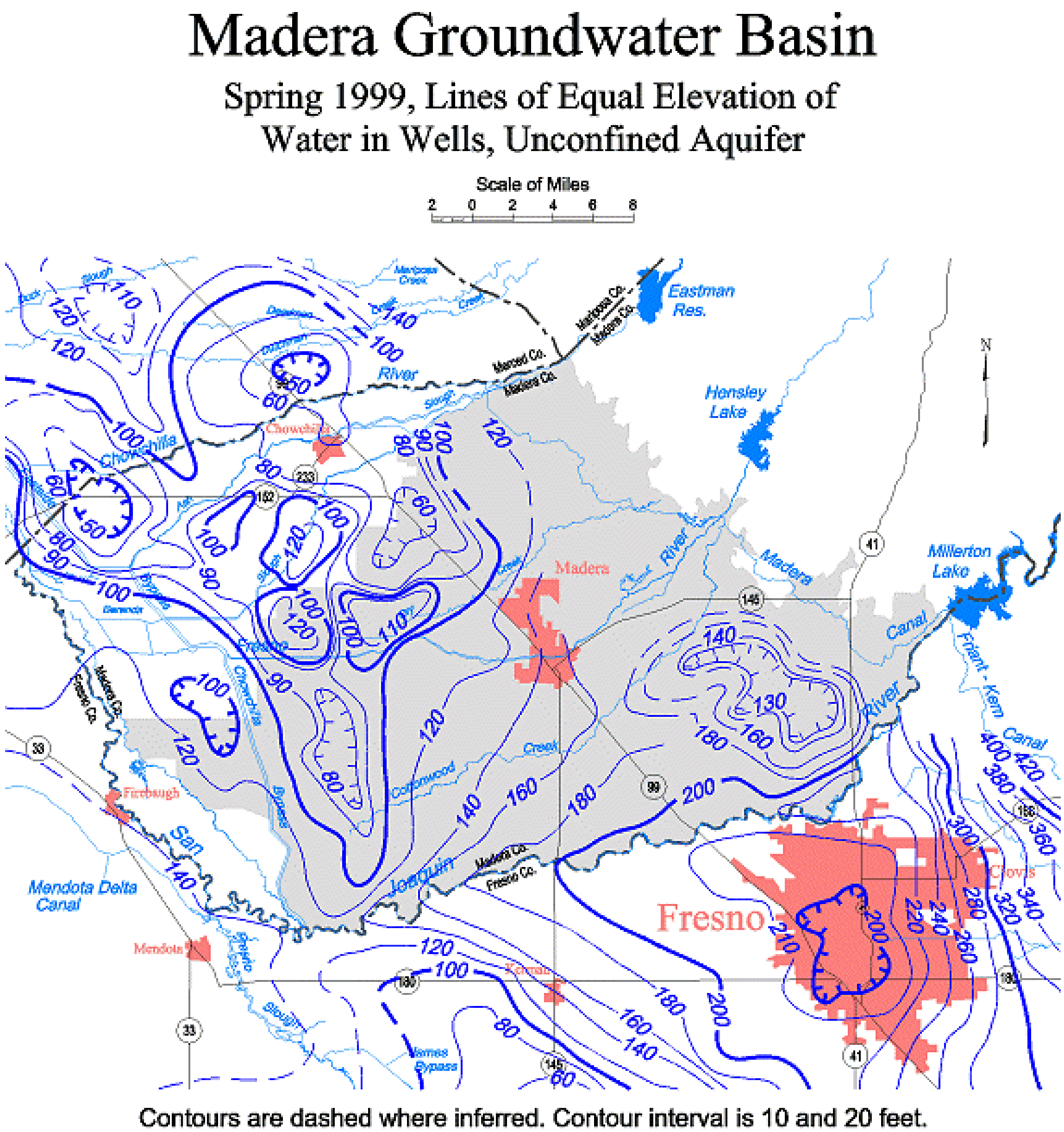
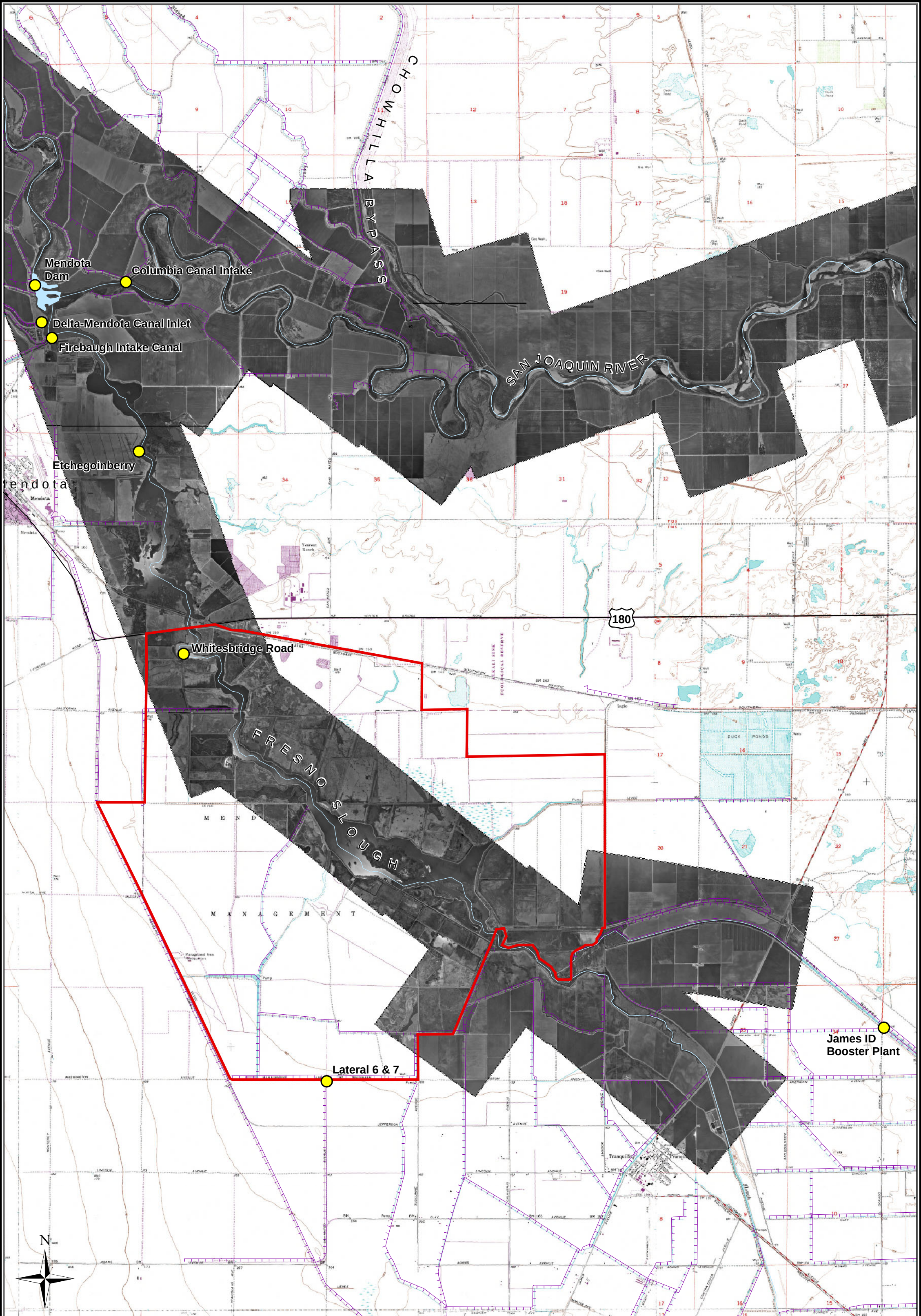


Figure 3-10. Madera Groundwater Elevations in Spring 1999. (Source: http://wwwpla.water.ca.gov/sid/groundwater)



Sediment Sampling Location

Sediment Sampling Location

Mendota Wildlife Area

CANAL/DITCH

1:70,000

1 0.5 0 1 2 Miles

NAD83 CA STATEPLANE FIPSZONE 403

Figure 3-11
Sediment Sampling Locations

ENTRIX

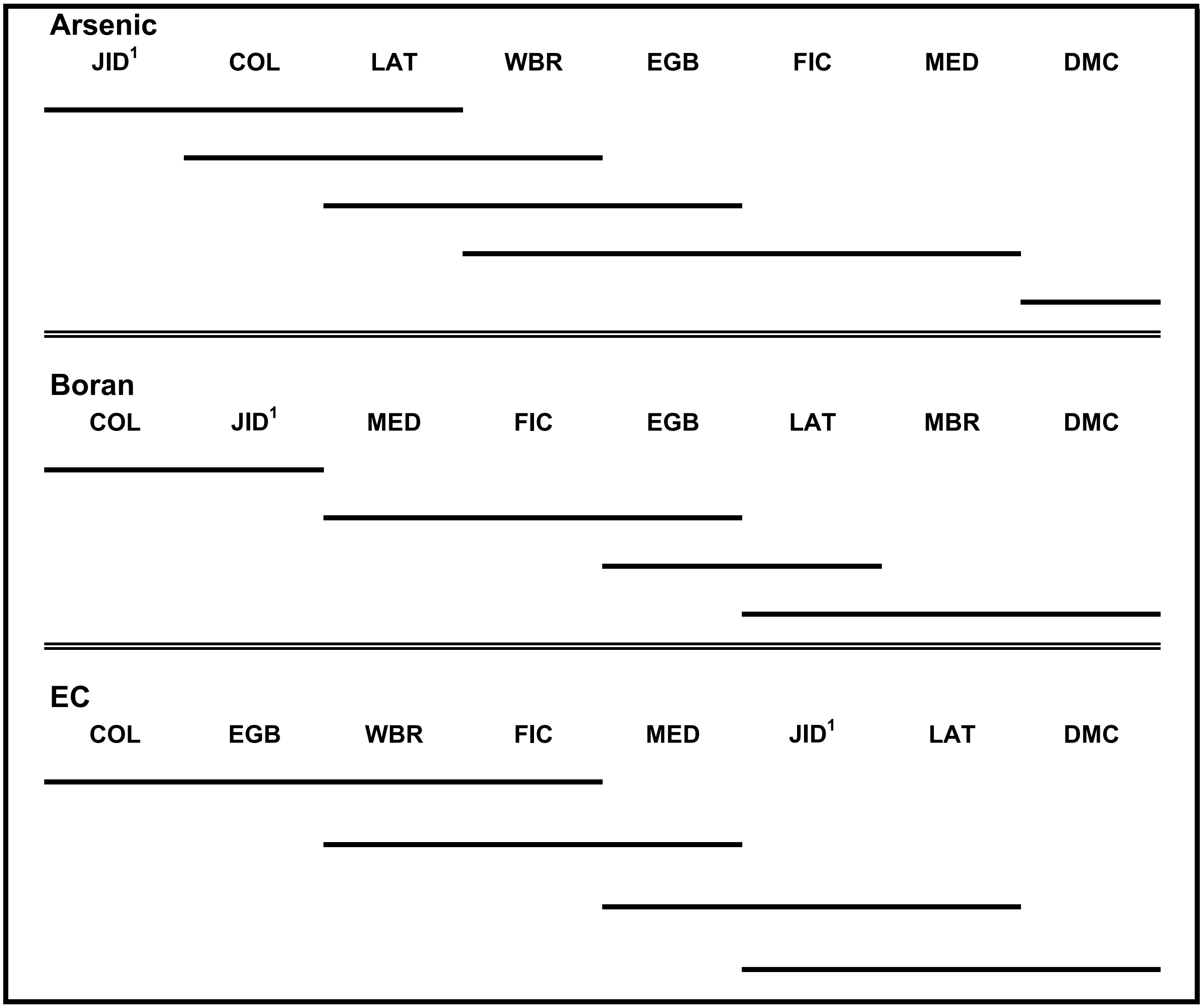


Figure3-12. Results of Least Significant Difference (LSD) test for arsenic, boron and, electrical conductivity (EC) in Mendota Pool Sediments (October 2001). Station concentrations are arranged from low to high values. Stations that are connected by a single line are considered to have similar concentrations.

[1]JID-James Irrigation District Booster Plant; LAT-Lateral 6; WBR-Whitesbridge Road; EGB-Etchegoinberry; FIC-Firebaugh Intake Canal; DMC-Delta-Mendota Canal; MED-Mendota Dam; COL-Columbia Canal Intake.

This section addresses the potential for environmental effects of the proposed 10-year pumping program (proposed action) and each alternative relative to each of the following primary resource areas:

- Groundwater levels
- Land subsidence
- Groundwater quality
- Surface water quality
- Sediment quality
- Biological resources
- Central Valley Project operations
- Archaeological and cultural resources
- Land use and traffic
- Noise
- Environmental justice
- Socioeconomic effects

The majority of potential impacts from the pumping program evaluated by WWD were determined to be less-than-significant in the draft and final EIRs (Jones and Stokes 1995; Jones and Stokes and LSCE 1998). A subsequent agreement (Settlement Agreement for Mendota Pool Transfer Pumping), modified the findings of the final EIR due to changes in the program design that reduced potential impacts from the project. Consistent with the Settlement Agreement and design changes incorporated into the 2001 and 2002 pumping programs (Reclamation 2001, 2002), the 10-year pumping program is designed to prevent impacts by reducing the volume of water pumped, adjusting the timing of pumping, and improving the overall quality of the water being pumped.

Potential effects on the primary resource areas are closely interrelated. Pumping by the MPG wells and nearby non-project wells would result in a localized lowering of the groundwater levels (drawdown) and the formation of a seasonal "cone of depression" in one or both of the shallow or deep layers of the upper aquifer. These lower groundwater elevations would result in increased pumping costs in nearby non-project wells. When the groundwater elevations in the aquifer are depressed, inelastic compaction of the clay layers may occur and result in land subsidence. Drawdown due to pumping would also result in an increase in the hydraulic gradient, thereby increasing the flow of groundwater from outlying areas toward the Mendota Pool. If the outlying areas have poorer water quality than that present near the Mendota Pool, then water quality degradation would occur. Finally, if the groundwater quality is poorer than the surface water quality, then pumping of this water into the Mendota Pool may result in a degradation of the surface water quality, which may affect biological resources.

4.1 GROUNDWATER LEVELS

The proposed action, or an alternative, would have a significant impact on groundwater levels if it would result in a reduction of water supply or increased extraction costs to other users. This analysis would address both short-term, localized effects and long-term effects such as overdraft.

The following discussion of potential effects on groundwater levels is based partly on water level data collected during the 1999, 2000, and 2001 MPG pumping programs and on the results of simulations conducted using the groundwater model. The 1999 and 2000 data are discussed in the Phase I report prepared by KDSA and LSCE (2000a) and the 2000 annual report (LSCE and KDSA 2001). The 2001 data are discussed in detail in the 2001 annual report (LSCE and KDSA 2002).

4.1.1 PROPOSED ACTION

Analytical groundwater models of the shallow and deep zones have been used since 1999 to predict drawdown and assess short-term impacts of transfer pumping at nearby wells (LSCE and KDSA 2001, 2002). These models are used to predict water level impacts within the study area during each year of the 10-year proposed action. The model of the shallow zone calculates drawdown above the A-clay using one set of parameters, and the deep zone model calculates drawdown between the A-clay and the Corcoran Clay using a different set of parameters. The models are based on the Hantush-Jacob (1955) equation that simulates leakage from overlying zones. The model of the deep zone is also used to calculate drawdowns for the subsidence estimates. Detailed discussions of these models are contained in the 2000 and 2001 Annual Reports (LSCE and KDSA 2001 and 2002). These models are summarized in Appendix D.2.

4.1.1.1 Short-term effects

During the 10-year duration of the proposed action, the maximum volume of water extracted annually would depend on the type of hydrologic year. The maximum volume extracted for transfer would be 31,600 acre-feet in a normal year or 40,000 acre-feet in a dry year. No pumping for transfer would occur during wet years. Transfer pumping would occur over no more than a 9-month period each year.

The majority of the transfer pumpage would be from shallow wells. Shallow pumpage would represent about 19,600 acre-feet of the 31,600 acre-feet that could be pumped in a normal year. There are no shallow water supply wells other than the MPG wells within the study area. Therefore, short-term drawdowns caused by MPG shallow pumping during normal years would not cause water level impacts for other users. The potential impact on shallow wells would be less-than-significant.

Under the proposed action, a maximum of 12,000 acre-feet of water would be pumped for transfer from the deep zone, primarily in the spring and fall. The reduced volume and extended duration of the deep zone pumping program would reduce drawdowns and minimize cost impacts to other groundwater pumpers in the area.

Measured drawdowns available from the water level monitoring program in 1999 through 2002 provide an indication of what is likely to occur in future years. The 2000 drawdowns were quite similar to the 1999 drawdowns in both magnitude and timing. In most of the deep wells, the maximum drawdowns occurred during the peak of the irrigation season (July or August). The MPG pumping program was modified for 2001 and 2002 so that the deep MPG wells did not pump for transfer between July 1 and September 15. In NLF and portions of FWD, the maximum drawdowns in 2001 and 2002 still occurred in July but were much smaller than in previous years. West of the Fresno Slough, the maximum drawdowns for the majority of wells in 2001 and 2002 occurred in September and August, respectively. These drawdowns were also considerably smaller than in previous years. Drawdowns during the 10-year program are expected to be smaller than in 2001, because future MPG deep zone pumping would be less than in 2001 and the deep MPG wells are scheduled to be off for a longer period during the summer. Also, pumping would be distributed over a longer period than during the 2000 through 2002 pumping programs, thereby resulting in less drawdown.

Because deep zone transfer pumping would occur primarily in the spring and fall under the proposed action, the model predicts that the annual cone of depression in the deep zone would reach its maximum areal extent at the end of May instead of during the summer months. Small residual deep zone drawdowns are predicted to occur in June due to pumping during March through May, but drawdowns in July and August are expected to be negligible. Of the non-MPG wells, the NLF wells near the San Joaquin River would experience the most drawdown due to the project. In May, several NLF wells near the River are predicted to experience slightly more that 25 feet of drawdown due to transfer pumping. This would decrease to about 10 feet for NLF wells located approximately one mile north of the River and to less than 5 feet for most wells east of the Chowchilla Bypass. The timing of the predicted water level impacts can be seen on hydrographs of simulated drawdowns at selected wells. Hydrographs were plotted for three wells north of FWD; these locations are shown on Figure 4-1 along with the deep MPG wells from which transfer pumping was simulated. Hydrographs (Figure 4-2) were plotted for NLF well No. 53 near the San Joaquin River, NLF well No. 77 about one mile north of the River, and Woolf Enterprises well No. 75 east of the Chowchilla Bypass in Aliso Water District. The drawdowns shown on these hydrographs are based on proposed MPG pumping during Year 2 of the proposed project (the first normal year in the 10-year simulation) and non-MPG pumpage from 2001 (measured or estimated). The maximum drawdown due to all pumping shown on these hydrographs occurs in August or September. MPG transfer pumping does not contribute measurably to the cumulative drawdown during the summer because of the timing of the deep zone transfer pumping.

Short-term project-related groundwater drawdown in the deep zone could cause the cost of obtaining water to increase for other nearby users. As part of the Settlement Agreement, the MPG agreed to pay compensation to well owners in the SJREC and NLF service areas as mitigation for increased power and other costs incurred due to drawdowns caused by the MPG transfer pumping. Beginning with the 2002 irrigation season, this compensation program was extended to include other major pumpers in the Mendota area. With this mitigation, the proposed action would result in less-than-significant short-term water level impacts to deep wells in the Mendota area.

Table 3-3. Most Recent Surface Water Quality Laboratory Results

Sample		EC	TDS	pH	SAR	As	B	Mo	Se
Date	Lab[1]	(µmhos/cm @25°C)	(mg/l)		(mg/l)	(ug/L)	(mg/L)	(ug/L)	(ug/L)
San Joaquin River Arm									
Columbia Canal									
07/19/2001	FGL	421	-	-	-	-	-	-	-
09/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
10/03/2001	BSK	630	-	-	-	-	0.2	-	DQO
06/25/2002	FGL	383	240	7.8	1.6	3	0.16	-	-
06/25/2002	OBL	-	-	-	-	-	-	5.1	0.71
Minimum detected value or detection limit		**383**	**240**	**7.8**	**1.6**	**3**	**0.16**	**5.1**	**0.71**
Maximum detected value		**660**	**240**	**7.8**	**1.6**	**3**	**0.20**	**5.1**	**0.71**
Mean of detected values		**524**	**240**	**7.8**	**1.6**	**3**	**0.19**	**5.1**	**0.71**
Northern Fresno Slough									
Mendota Dam									
07/19/2001	FGL	390	-	-	-	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	<0.25	3.4	0.59
11/05/2001	FGL	668	380	8.0	2.7	<2	0.25	-	-
11/05/2001	OBL	-	-	-	-	-	-	2.8	0.59
06/25/2002	FGL	344	210	7.9	1.4	3	0.15	-	-
06/25/2002	OBL	-	-	-	-	-	-	1.6	0.68
CCID Main Canal									
01/03/2001	USBR	222	-	7.9	-	-	-	-	-
01/03/2001	OBL	-	-	-	-	-	-	-	0.65
02/07/2001	USBR	595	-	7.7	-	-	-	-	-
02/07/2001	OBL	-	-	-	-	-	-	-	1.08
03/08/2001	USBR	562	-	7.7	-	-	-	-	-
03/08/2001	OBL	-	-	-	-	-	-	-	2.32
04/03/2001	USBR	778	-	-	-	-	-	-	-
04/03/2001	OBL	-	-	-	-	-	-	-	2.96
05/09/2001	USBR	513	-	-	-	-	-	-	-
05/09/2001	OBL	-	-	-	-	-	-	-	0.56
06/06/2001	USBR	488	-	-	-	-	-	-	-
06/06/2001	OBL	-	-	-	-	-	-	-	0.99
06/26/2001	USBR	452	-	-	-	-	-	-	-
06/26/2001	OBL	-	-	-	-	-	-	-	<0.4
07/19/2001	FGL	410	-	-	-	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	<0.25	3.6	0.6
07/24/2001	USBR	423	-	-	-	-	-	-	-
07/24/2001	OBL	-	-	-	-	-	-	-	0.89
08/29/2001	USBR	639	-	-	-	-	-	-	-
08/29/2001	OBL	-	-	-	-	-	-	-	0.78
09/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
10/02/2001	USBR	720	-	-	-	-	-	-	-
10/02/2001	OBL	-	-	-	-	-	-	-	0.48
10/03/2001	BSK	630	-	-	-	-	0.2	-	DQO
10/30/2001	USBR	666	-	-	-	-	-	-	-
10/30/2001	OBL	-	-	-	-	-	-	-	<0.4

Table 3-3. Most Recent Surface Water Quality Laboratory Results

Sample		EC	TDS	pH	SAR	As	B	Mo	Se
Date	Lab[1]	(µmhos/cm @25°C)	(mg/l)		(mg/l)	(ug/L)	(mg/L)	(ug/L)	(ug/L)
11/05/2001	FGL	657	390	8.0	2.8	<2	0.21	-	-
11/05/2001	OBL	-	-	-	-	-	-	3.3	0.57
12/05/2001	USBR	982	-	-	-	-	-	-	-
12/05/2001	OBL	-	-	-	-	-	-	-	0.82
01/08/2002	USBR	698	-	-	-	-	-	-	-
02/07/2002	USBR	197	-	-	-	-	-	-	-
06/25/2002	FGL	387	240	7.9	1.5	3	0.17	-	-
06/25/2002	OBL	-	-	-	-	-	-	4.2	0.79
Mowry Bridge									
07/19/2001	FGL	430	-	-	-	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	<0.25	3.6	0.7
11/05/2001	FGL	652	370	7.9	2.8	<2	0.2	-	-
11/05/2001	OBL	-	-	-	-	-	-	2.62	0.51
06/25/2002	FGL	359	250	7.7	0.1	2	0.17	-	-
06/25/2002	OBL	-	-	-	-	-	-	1.3	0.81
DMC Check 21									
01/03/2001	USBR	358	-	7.7	-	-	-	-	-
01/03/2001	OBL	-	-	-	-	-	-	-	<0.4
02/07/2001	USBR	570	-	7.8	-	-	-	-	-
02/07/2001	OBL	-	-	-	-	-	-	-	1.75
03/08/2001	USBR	543	-	7.7	-	-	-	-	-
03/08/2001	OBL	-	-	-	-	-	-	-	2.38
04/03/2001	USBR	857	-	-	-	-	-	-	-
04/03/2001	OBL	-	-	-	-	-	-	-	3.32
05/09/2001	USBR	524	-	-	-	-	-	-	-
05/09/2001	OBL	-	-	-	-	-	-	-	0.84
06/06/2001	USBR	495	-	-	-	-	-	-	-
06/06/2001	OBL	-	-	-	-	-	-	-	0.86
06/26/2001	USBR	434	-	-	-	-	-	-	-
06/26/2001	OBL	-	-	-	-	-	-	-	<0.4
07/19/2001	FGL	418	-	-	-	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	<0.25	3.1	0.67
07/24/2001	USBR	469	-	-	-	-	-	-	-
07/24/2001	OBL	-	-	-	-	-	-	-	0.8
08/29/2001	USBR	620	-	-	-	-	-	-	-
08/29/2001	OBL	-	-	-	-	-	-	-	0.66
09/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
09/20/2001	FGL	770	479	8.1	3.6	3	0.25	2	DQO
10/02/2001	USBR	686	-	-	-	-	-	-	-
10/02/2001	OBL	-	-	-	-	-	-	-	0.48
10/03/2001	BSK	570	-	-	-	-	0.2	-	DQO
10/30/2001	USBR	676	-	-	-	-	-	-	-
10/30/2001	OBL	-	-	-	-	-	-	-	<0.4
11/05/2001	FGL	651	380	7.9	2.8	<2	0.2	-	-
11/05/2001	OBL	-	-	-	-	-	-	2.98	0.5
12/05/2001	USBR	767	-	-	-	-	-	-	-

Table 3-3. Most Recent Surface Water Quality Laboratory Results

Sample		EC	TDS	pH	SAR	As	B	Mo	Se
Date	Lab[1]	(μmhos/cm @25°C)	(mg/l)		(mg/l)	(ug/L)	(mg/L)	(ug/L)	(ug/L)
12/05/2001	OBL	-	-	-	-	-	-	-	1.56
01/08/2002	USBR	687	-	-	-	-	-	-	-
02/07/2002	USBR	698	-	-	-	-	-	-	-
06/05/2002	FGL	504	320	7.9	1.9	-	0.24	-	-
06/05/2002	OBL	-	-	-	-	-	-	1.0	1.19
06/25/2002	FGL	340	220	7.7	0.1	<2	0.15	-	-
06/25/2002	OBL	-	-	-	-	-	-	1.3	0.78
07/09/2002	FGL	321	210	8.0	1.4	-	0.15	-	-
08/09/2002	FGL	474	270	7.5	2.4	2	0.13	-	-
08/09/2002	OBL	-	-	-	-	-	-	<1.0	0.79
09/08/2002	FGL	535	304	7.8	2.4	-	0.14	-	-
09/20/2002	FGL	623	360	-	-	-	-	-	-
CCID Outside Canal									
01/03/2001	USBR	592	-	7.8	-	-	-	-	-
01/03/2001	OBL	-	-	-	-	-	-	-	<0.4
02/07/2001	USBR	514	-	7.8	-	-	-	-	-
02/07/2001	OBL	-	-	-	-	-	-	-	1.1
03/08/2001	USBR	550	-	7.7	-	-	-	-	-
03/08/2001	OBL	-	-	-	-	-	-	-	2.18
04/03/2001	USBR	683	-	-	-	-	-	-	-
04/03/2001	OBL	-	-	-	-	-	-	-	2.69
05/09/2001	USBR	525	-	-	-	-	-	-	-
DMC Check 21 (cont'd)									
05/09/2001	OBL	-	-	-	-	-	-	-	0.95
06/06/2001	USBR	463	-	-	-	-	-	-	-
06/06/2001	OBL	-	-	-	-	-	-	-	0.92
06/26/2001	USBR	445	-	-	-	-	-	-	-
06/26/2001	OBL	-	-	-	-	-	-	-	<0.4
07/19/2001	FGL	417	-	-	-	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	<0.25	3.8	0.69
07/24/2001	USBR	479	-	-	-	-	-	-	-
07/24/2001	OBL	-	-	-	-	-	-	-	1.0
08/29/2001	USBR	624	-	-	-	-	-	-	-
08/29/2001	OBL	-	-	-	-	-	-	-	0.93
09/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
10/02/2001	USBR	731	-	-	-	-	-	-	-
10/02/2001	OBL	-	-	-	-	-	-	-	0.4
10/03/2001	BSK	680	-	-	-	-	0.2	-	DQO
10/30/2001	USBR	667	-	-	-	-	-	-	-
10/30/2001	OBL	-	-	-	-	-	-	-	0.49
11/05/2001	FGL	662	370	8.0	2.9	<2	0.2	-	-
11/05/2001	OBL	-	-	-	-	-	-	2.48	0.51
12/05/2001	USBR	866	-	-	-	-	-	-	-
12/05/2001	OBL	-	-	-	-	-	-	-	0.68
01/08/2002	USBR	887	-	-	-	-	-	-	-
02/07/2002	USBR	336	-	-	-	-	-	-	-

Table 3-3. Most Recent Surface Water Quality Laboratory Results

Sample		EC	TDS	pH	SAR	As	B	Mo	Se
Date	Lab[1]	(µmhos/cm @25°C)	(mg/l)		(mg/l)	(ug/L)	(mg/L)	(ug/L)	(ug/L)
06/25/2002	FGL	387	250	7.7	0.1	<2	0.17	-	-
06/25/2002	OBL	-	-	-	-	-	-	1.9	0.83
Firebaugh Intake Canal									
07/19/2001	FGL	423	-	-	-	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	<0.25	3.5	0.67
09/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
10/03/2001	BSK	590	-	-	-	-	0.2	-	DQO
11/05/2001	FGL	664	390	8.0	2.8	<2	0.22	-	-
11/05/2001	OBL	-	-	-	-	-	-	3.1	0.46
06/25/2002	FGL	401	260	7.9	0.1	2	0.18	-	-
06/25/2002	OBL	-	-	-	-	-	-	2.1	0.84
West of Fordel									
07/19/2001	FGL	390	-	-	-	-	-	-	-
11/05/2001	FGL	675	380	8.7	3.0	<2	0.2	-	-
11/05/2001	OBL	-	-	-	-	-	-	2.42	0.505
06/25/2002	FGL	358	220	8.7	0.1	3	0.16	-	-
06/25/2002	OBL	-	-	-	-	-	-	1.4	0.71
Minimum detected value or detection limit		**197**	**210**	**7.5**	**0.1**	**2**	**0.13**	**1.00**	**<0.4**
Maximum detected value		**982**	**479**	**8.7**	**3.6**	**3**	**0.25**	**4.20**	**3.32**
Mean of detected values		**560**	**313**	**7.9**	**1.8**	**3**	**0.19**	**2.61**	**0.99**
Central Fresno Slough									
Etchegoinberry									
07/19/2001	FGL	423	-	-	-	-	-	-	-
11/05/2001	FGL	854	500	8.2	4.7	<2	0.3	-	-
11/05/2001	OBL	-	-	-	-	-	-	4.05	0.47
06/25/2002	FGL	439	280	8.0	1.9	3	0.18	-	-
06/25/2002	OBL	-	-	-	-	-	-	2.4	0.67
Minimum detected value or detection limit		**423**	**280**	**8.0**	**1.9**	**<2**	**0.18**	**2.40**	**0.47**
Maximum detected value		**854**	**500**	**8.2**	**4.7**	**3**	**0.30**	**4.05**	**0.67**
Mean of detected values		**572**	**390**	**8.1**	**3.3**	**3**	**0.24**	**3.23**	**0.57**
Southern Fresno Slough									
Mendota Wildlife Area[2]									
01/31/2001	FGL	853	540	7.8	4.3	-	0.28	-	-
02/22/2001	FGL	682	430	7.8	2.7	-	0.33	-	-
03/28/2001	FGL	670	440	7.9	3.1	-	0.35	-	-
04/25/2001	FGL	772	490	8.2	4.0	-	0.41	-	-
05/30/2001	FGL	1,030	650	8.5	6.1	<2	0.32	6	DQO
06/26/2001	FGL	711	457	8.4	4.1	2	0.26	4	DQO
07/19/2001	FGL	573	367	8.8	3.2	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	0.2	4.2	0.62
08/15/2001	FGL	660	430	9.0	4.0	2	0.21	3	DQO
09/10/2001	FGL	1,010	600	-	-	-	-	-	-
09/20/2001	FGL	777	492	8.7	4.3	2	0.21	3	DQO
11/05/2001	FGL	1060	610	8.4	6.2	<2	0.33	-	-

Table 3-3. Most Recent Surface Water Quality Laboratory Results

Sample		EC	TDS	pH	SAR	As	B	Mo	Se
Date	Lab[1]	(µmhos/cm @25°C)	(mg/l)		(mg/l)	(ug/L)	(mg/L)	(ug/L)	(ug/L)
11/05/2001	OBL	-	-	-	-	-	-	8.42	<0.4
06/05/2002	FGL	678	440	8.4	3.3	-	0.22	-	-
06/05/2002	OBL	-	-	-	-	-	-	2.0	0.73
06/25/2002	FGL	667	410	8.6	0.1	<2	0.23	-	-
06/25/2002	OBL	-	-	-	-	-	-	3.0	0.7
07/09/2002	FGL	533	340	8.6	2.9	-	0.20	-	-
07/15/2002	FGL	514	330	-	-	-	-	-	DQO
07/25/2002	FGL	500	280	-	-	-	-	-	-
08/09/2002	FGL	659	400	8.4	3.9	<2	0.17	-	-
08/09/2002	OBL	-	-	-	-	-	-	2.2	0.54
08/14/2002	FGL	613	370	-	-	-	-	-	-
08/19/2002	FGL	658	400	-	-	-	-	-	-
09/08/2002	FGL	849	515	8.3	4.2	-	0.3	-	-
09/20/2002	FGL	824	500	-	-	-	-	-	-
Lateral 6 & 7									
01/31/2001	FGL	742	480	7.8	3.9	-	0.25	-	-
02/22/2001	FGL	787	500	8.4	3.5	-	0.27	-	-
03/28/2001	FGL	680	450	8.4	2.9	-	0.32	-	-
04/25/2001	FGL	718	480	8.5	4.5	-	0.26	-	-
05/30/2001	FGL	1,020	650	8.4	5.2	<2	0.33	5	DQO
06/26/2001	FGL	820	529	9.0	4.5	4	0.33	6	DQO
07/19/2001	FGL	677	446	8.7	3.8	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	0.23	5.5	0.69
08/15/2001	FGL	685	440	8.7	4.5	3	0.21	3	DQO
09/20/2001	FGL	1,020	650	8.4	5.7	3	0.27	5	DQO
11/05/2001	FGL	889	560	8.5	4.8	<2	0.26	-	-
11/05/2001	OBL	-	-	-	-	-	-	5.42	0.475
06/05/2002	FGL	720	470	8.2	3.5	-	0.25	-	-
06/05/2002	OBL	-	-	-	-	-	-	1.0	0.9
07/09/2002	FGL	459	300	8.2	2.3	-	0.23	-	-
07/15/2002	FGL	533	340	-	-	-	-	-	DQO
07/25/2002	FGL	522	310	-	-	-	-	-	-
08/09/2002	FGL	675	420	8.0	3.8	2	0.21	-	-
08/09/2002	OBL	-	-	-	-	-	-	1.6	0.512
08/14/2002	FGL	680	390	-	-	-	-	-	-
08/19/2002	FGL	680	410	-	-	-	-	-	-
09/08/2002	FGL	742	451	8.2	3.7	-	0.2	-	-
09/20/2002	FGL	874	540	-	-	-	-	-	-
James ID (Booster Plant)									
01/31/2001	FGL	710	450	8.2	4.2	-	0.3	-	-
03/28/2001	FGL	805	510	8.6	4.1	-	0.35	-	-
04/25/2001	FGL	826	550	8.4	6.4	-	0.37	-	-
05/30/2001	FGL	824	540	8.7	5.7	10	0.38	8	DQO
06/26/2001	FGL	784	514	8.7	4.4	2	0.29	5	DQO
07/19/2001	FGL	665	442	8.6	3.8	-	-	-	-
07/19/2001	OBL	-	-	-	-	<3	0.23	4.9	0.57

Table 3-3. Most Recent Surface Water Quality Laboratory Results

Sample		EC	TDS	pH	SAR	As	B	Mo	Se
Date	Lab[1]	(µmhos/cm @25°C)	(mg/l)		(mg/l)	(ug/L)	(mg/L)	(ug/L)	(ug/L)
08/15/2001	FGL	687	440	8.5	3.9	3	0.21	3	DQO
09/20/2001	FGL	1,030	656	8.2	5.6	3	0.28	5	DQO
11/05/2001	FGL	933	580	8.4	4.8	<2	0.27	-	-
11/05/2001	OBL	-	-	-	-	-	-	6.68	0.585
06/05/2002	FGL	708	440	8.0	3.4	-	0.25	-	-
06/05/2002	OBL	-	-	-	-	-	-	2.0	0.95
07/09/2002	FGL	463	300	8.3	2.4	-	0.22	-	-
07/15/2002	FGL	530	320	-	-	-	-	-	DQO
07/25/2002	FGL	512	310	-	-	-	-	-	-
08/09/2002	FGL	672	420	7.7	2.5	2	0.13	-	-
08/09/2002	OBL	-	-	-	-	-	-	1.2	0.638
08/14/2002	FGL	666	390	-	-	-	-	-	-
08/19/2002	FGL	671	400	-	-	-	-	-	-
09/08/2002	FGL	737	470	8.1	3.6	-	0.22	-	-
09/20/2002	FGL	860	510	-	-	-	-	-	-
Tranquillity ID Intake									
07/25/2002	FGL	540	320	-	-	-	-	-	DQO
08/09/2002	FGL	712	410	-	-	-	-	-	DQO
08/14/2002	FGL	703	420	-	-	-	-	-	DQO
08/19/2002	FGL	672	390	-	-	-	-	-	DQO
09/08/2002	FGL	1570	925	8.0	12.2	-	1.29	-	DQO
09/20/2002	FGL	1790	1080	-	-	-	-	-	DQO
Minimum detected value or detection limit		**459**	**280**	**7.7**	**0.1**	**<2**	**0.13**	**1.00**	**<0.4**
Maximum detected value		**1,790**	**1,080**	**9.0**	**12.2**	**10**	**1.29**	**8.42**	**0.95**
Mean of detected values		**754**	**470**	**8.4**	**4.2**	**3**	**0.29**	**4.16**	**0.66**

1. Laboratory Abbreviations: BSK - BSK Analytical Laboratories, Fresno, CA; FGL - Fruit Growers Laboratory, Santa Paula, CA; USBR - U.S. Bureau of Reclamation, hydrolab field measurement (EC), OBL - Olson Biochemistry Lab, Brookings, SD; OBL - Olson Biochemistry Lab, Brookings, SD
2. Until the EC analysis on 11/18/2000, samples were taken one mile south of Whitesbridge Road. From the complete chemical analysis (11/18/2000) until 4/25/2001 samples were taken at Whitesbridge Road. Subsequent samples were taken one quarter mile south of Whitesbridge Road. The sample taken on 8/15/2001 and subsequent samples were taken at Whitesbridge Road.

DQO = Data quality objectives for this analysis were not met for this sample. Results are not included in the EIS evaluation of this parameter.Results are reported in Appendix C.

Guidelines for calculating the amount of compensation are provided in the Settlement Agreement. At the end of each year, consultants to the MPG, SJREC, and NLF would review the water level and pumpage data for all wells in the study area and use the groundwater flow model to determine how much of the drawdown measured at each production well is caused by MPG transfer pumping. Compensation would be determined based on this estimated drawdown, metered monthly pumpage, and actual power costs. In 2001, the majority of the compensation was paid to NLF, which operates a number of deep wells near the MPG wells in FWD. Compensation amounts for more distant wells were small, because the majority of the drawdown caused by transfer pumping does not extend very far beyond the vicinity of the MPG wells. Compensation for increased pumping costs would also be paid to well owners who were not parties to the Settlement Agreement at their request. This compensation would be calculated similarly and paid to well owners in the study area who provide the necessary monthly pumpage data.

4.1.1.2 Long-term effects

Data collected through 2002 do not indicate that overdraft is occurring near the Mendota Pool. If overdraft were to occur due to the project, it would be most apparent in wells near the MPG wells where water level impacts are largest. The Settlement Agreement states that MPG transfer pumping would be reduced if there is evidence that the pumping is causing long-term overdraft.

Water levels in the area just north of the San Joaquin River branch of the Pool are being closely monitored because the potential for overdraft appears to be high. The residual drawdowns (lack of full recovery) that have occurred in several deep wells in NLF near the San Joaquin River since 1999 are partially attributed to MPG pumping. Residual drawdowns in other NLF wells near the northern and eastern boundaries of NLF are caused by pumping within NLF and in the historically overdrafted portions of Madera County (north and east of NLF), rather than by MPG pumping. Residual drawdowns in NLF due to MPG pumping are not anticipated in 2002, because the 2002 transfer pumpage was reduced considerably to minimize water level and subsidence impacts.

Overdraft has been occurring in portions of western Madera County northeast of Mendota for decades, with many wells south of the Chowchilla area experiencing more than 100 feet of water level decline. Groundwater elevation contour maps of the deep aquifer in the Mendota area produced by DWR (1989-2000) and LSCE and KDSA (2001 and 2002) indicate that groundwater flows into this cone of depression from all directions. This results in lower groundwater levels in the surrounding area, including FWD.

Groundwater flow beneath the San Joaquin River into Madera County is not a natural condition but is induced by pumping in the overdrafted areas. The majority of the groundwater flow into western Madera County comes from the vicinity of the San Joaquin River upstream of Gravelly Ford and beneath the River downstream of Mendota Dam. MPG pumping has no measurable effect on groundwater flow in these areas. A much smaller amount of groundwater flow into western Madera County occurs to the northeast beneath the San Joaquin River upstream of Mendota Dam. Due to pumping on both sides of the River and lack of recharge from the River since the construction of Friant Dam, the gradient for flow is fairly flat in this area, and the amount of northeasterly groundwater flow into Madera County from this area is relatively small. Groundwater elevation contour maps show that MPG pumping in FWD does not cause a reversal of gradient in this area. Therefore, the northeasterly flow beneath the San Joaquin River continues when the MPG wells in FWD are pumping. Reductions in flow due to MPG transfer pumping are expected to be small and would not cause a measurable increase in the amount of overdraft northeast of FWD.

The proposed action and the two no action alternatives would result in a less-than-significant impact to overdrafted portions of Madera County. The center of the overdrafted area would not continue to move south unless there are further increases in the volume of groundwater pumping east of the Chowchilla Bypass by non-MPG pumpers in Madera County. Additional recharge from the River would be expected to reduce the size of the overdrafted area if year round flows are reestablished in the reach of the San Joaquin River downstream of Gravelly Ford.

The monitoring program would continue throughout the 10-year period of the proposed action and would ensure that long-term overdraft of the aquifer does not occur in the Mendota area due to MPG transfer pumping. Determination of overdraft conditions would be made based on evaluation of the results from the groundwater monitoring program by the hydrologists representing the MPG, NLF, and SJREC. Furthermore, the MPG has agreed to reduce transfer pumping if there is evidence that this pumping is causing long-term overdraft. Pumping programs would be designed on an annual basis and would be based on the results of the previous years monitoring efforts. If there is evidence of incomplete recovery of groundwater levels between years, the amount of water pumped from the deep zone would be reduced in the following year to allow water levels to recover.

The effects of the proposed action on groundwater levels are less-than-significant due to the adaptive management of the annual pumping programs.

4.1.2 New Well Construction

4.1.2.1 Short-term effects

Under this alternative, a maximum of 9,000 acre-feet per year could be exchanged with other users around the Pool. This would result in some localized drawdown, but would be less than that expected under the proposed action. Based on effects observed during the 2001 pumping program, this amount of pumping would not result in sufficient additional drawdown to be detectable by the MPG monitoring program and attributed to MPG pumping.

MPG pumping in SLWD and WWD would occur in the confined aquifer below the Corcoran Clay. Pumping from this aquifer would result in additional drawdowns at nearby user's wells. Because this pumping would not be classified as transfer pumping, these drawdowns would not be compensated by the Pool Group. Therefore, this alternative could result in a significant short-term effect on other well owners in WWD and SLWD.

4.1.2.2 Long-term effects

This alternative would result in less drawdown in the Mendota area than the proposed action due to reduced pumping from the deep zone in the vicinity of Mendota Pool. This alternative would result in additional long-term drawdown in SLWD and WWD as compared to current conditions. The aquifer in WWD has a maximum safe yield of approximately 135,000 to 200,000 acre-feet per year (WWD 2002). Groundwater extraction between 1999 and 2002, in WWD ranged from a minimum of 60,600 acre-feet in 1999 to a maximum of 225,000 acre-feet in 2000 (Table 3-6). Pumping of an additional 25,000 acre-feet per year in WWD may result in overdraft of the aquifer in this region. Similarly, this alternative would result in additional drawdown in SLWD as compared to current conditions. This would be a significant adverse effect.

This alternative would not impact overdrafted portions of Madera County. Pumping in SLWD and WWD would not cause water level impacts in Madera County due to the distance between these areas. The cone of depression in the overdrafted area of Madera County would not expand to the south unless there are further increases in the volume of groundwater pumping east of the Chowchilla Bypass by non-MPG pumpers. Additional recharge from the River would be expected to reduce the size of the overdrafted area if year round flows are reestablished in this reach of the San Joaquin River.

4.1.3 LAND FALLOWING

4.1.3.1 Short-term effects

Under this alternative, a maximum of 9,000 acre-feet per year could be exchanged with other users around the Pool. This would result in some localized drawdown, but would be less than that expected under the proposed action. Based on effects observed during the 2001 pumping program, this amount of pumping would not result in sufficient additional drawdown to be detectable by the MPG monitoring program and attributed to MPG pumping.

No pumping would occur in SLWD or WWD under this alternative. Therefore, this alternative would have no effect on short-term groundwater level changes in these areas.

4.1.3.2 Long-term effects

No additional pumping would occur in SLWD or WWD under this alternative. Therefore, this alternative would not have an effect on long-term groundwater levels in SLWD or WWD. The land fallowing alternative would result in a less-than-significant impact to overdrafted portions of Madera County. The cone of depression in the overdrafted area would not continue to expand to the south unless there are further increases in the volume of groundwater pumping east of the Chowchilla Bypass by non-MPG pumpers. Additional recharge from the San Joaquin River would be expected to reduce the size of the overdrafted area if year round flows are reestablished in the reach downstream of Gravelly Ford.

4.1.4 CUMULATIVE EFFECTS ON GROUNDWATER LEVELS

Surface water resources are fully allocated at present. Future regulations may further limit the quantity of surface water available for agricultural uses. Therefore, any additional demands for water, either municipal or agricultural, would likely be met by extracting groundwater. The net effect of these demands would be to further lower groundwater levels on a regional basis. This would increase the cost of groundwater extraction and potentially make existing wells non-functional. Because of the geologic conditions within the San Joaquin Valley, overdraft in one area may affect other areas, particularly those that are nearby and immediately upgradient or downgradient. However, groundwater overdraft is not occurring in the Mendota area at present and is not anticipated to occur in the future.

Overdraft has occurred for decades in western Madera County east of the Chowchilla Bypass. The overdraft is indicated by steadily declining groundwater levels in wells monitored by Reclamation and DWR. The approximate location of this overdrafted area is indicated by the cone of depression shown on groundwater elevation contour maps prepared by DWR. In 1989, the center of this cone of depression was located approximately 10 miles north of the San Joaquin River. By 2000, the cone of depression had expanded in a southerly direction so that the center was about nine miles north of the River. The expansion of the cone of depression is primarily due to additional wells and increased pumping resulting from land use changes in Madera County during the past decade. During this period, a significant amount of acreage was converted from native vegetation and crops such as grain to crops such as almonds, grapes, and alfalfa, which have much higher water requirements. Most of this area has limited surface water rights and relies primarily on groundwater. Increased pumping in the area causes overdraft due to geologic conditions and the lack of any major surface water features to provide groundwater recharge. The proposed action would not have a measurable effect on groundwater conditions in the overdrafted portions of Madera County.

The City of Mendota's proposal to exchange 2,400 acre-feet of groundwater pumped into the Fresno Slough from the Fordel wells or other wells west of the Slough for groundwater from its new wells on the B&B Ranch east of the Slough would shift groundwater drawdowns from existing City wells to other wells closer to the Slough. This exchange is to compensate B&B Ranch for the groundwater removed by the City's new wells. This action would discontinue municipal pumpage from the City's old wells, and shift that pumpage to exchange pumpage from the Fordel wells. This would not increase pumpage or drawdowns west of the Slough overall.

The proposed action would not increase future demand for groundwater or limit surface water resources. Under all alternatives, some short-term drawdown would occur in the deep zone along Fresno Slough during the summer due to adjacent use pumping. Because the deep wells would not pump for transfer during the summer under the proposed action, the maximum drawdown during the irrigation season, which typically occurs in July or August, would not change significantly. The annual pumping programs would be designed to allow recovery of groundwater levels during the winter months to the pre-irrigation season levels.

Under the New Well Construction or Land Fallowing alternatives, there would be much less of an effect on drawdowns near Mendota Pool due to reduced pumping from both the deep and shallow zones. The New Well Construction alternative is expected to have short-term effects on groundwater levels below the Corcoran Clay. In addition, this alternative could contribute to overdraft of the groundwater aquifer below the Corcoran clay if groundwater demands in WWD remain at current levels or increase.

4.2 LAND SUBSIDENCE

The proposed action, or an alternative, would have a significant impact on land subsidence if it would result in subsidence greater than an average of 0.005 ft per year in the vicinity of the Pool, or result in damage to structures such as canals, well casings, or buildings, or substantially alter flooding patterns.

The subsistence criterion is monitored at the Yearout Ranch and Fordel extensomenters (Figure 2-1). In the Phase II report (KDSA and LSCE 2000b), a subsidence threshold of an average of 0.005 foot per year at the Yearout Ranch extensometer was identified. This criterion was selected for three reasons: 1) it is the minimum subsidence that could be detected over the given period, 2) the Yearout Ranch extensometer is located near FWD and Spreckels Sugar Co. (Figure 2-1) in an area that has historically experienced relatively large drawdowns, and 3) the Yearout Ranch extensometer has a relatively long dataset with which to compare current and historic subsidence rates. This criterion is also applied to compaction measured at the Fordel extensometer west of the Fresno Slough.

As discussed in Section 3.4.3, subsidence occurs in the San Joaquin Valley primarily as a result of inelastic compaction of lacustrine deposits and Coast Range alluvium in the western and southern parts of the Valley due to pumping from the lower aquifer below the Corcoran Clay. Much less compaction occurs in coarser-grain sediments such as the Sierran sands in the eastern half of the Valley. Compaction in the Sierran sands is primarily elastic and is much less likely to cause irreversible subsidence.

4.2.1 PROPOSED ACTION

In the Mendota area, groundwater is primarily pumped from the aquifers above the Corcoran Clay, which are composed primarily of Sierran sands. Historical compaction data indicate that compaction in this formation is primarily elastic. Compaction has been measured since 1999 at the Yearout Ranch extensometer by the SJREC and at the Fordel extensometer by the MPG. Data from both extensometers would be used to monitor subsidence caused by pumping related to the proposed action.

Shallow zone pumping is less likely to result in subsidence, because the drawdowns are smaller and more localized to the vicinity of the shallow wells. Most subsidence in the Mendota area is considered to be due to deep zone pumping (between the A-clay and the Corcoran Clay). As discussed in Section 3.4.3.1, data indicate that subsidence due to inelastic compaction above the Corcoran Clay from all pumping in 2000 was approximately 0.002 foot at the Fordel extensometer and 0.014 foot at the Yearout Ranch extensometer (LSCE and KDSA 2001). The amount of subsidence attributed to MPG transfer pumping at the Yearout Ranch extensometer in 2000 was 0.0045 foot. Subsidence was greater at both locations in 2001, partly because MPG deep zone transfer pumping exceeded 12,000 acre-feet. Total subsidence due to pumping by both MPG and others above the Corcoran Clay in 2001 was approximately 0.003 foot at the Fordel extensometer and 0.021 foot at the Yearout extensometer. The amount of subsidence at the Yearout Ranch extensometer attributed to MPG transfer pumping in 2001 was about 0.01 foot.

Based on these results, annual pumping programs in normal and dry years under the proposed action would likely include less deep zone pumping to reduce the potential for future subsidence. This action is part of the adaptive management and monitoring program that would be implemented throughout 10-year duration of the proposed action. The criterion of an average of 0.005 foot per year allows for subsidence to be greater than 0.005 foot in some years, and less in others. Under the proposed action, no transfer pumping would occur in each of two wet years, and subsidence from MPG transfer pumping would be negligible in those years. Because transfer pumpage would be reduced as necessary to ensure less than 0.05 foot of total subsidence over the 10-year period, the proposed action would result in less-than-significant subsidence in the Mendota Area.

4.2.2 New Well Construction

Under either of the No Action Alternatives, up to 9,000 acre-feet of water would be pumped into the Pool for exchange with other users around the Pool each year, regardless of the type of water year.

The New Well Construction alternative could result in significant subsidence in SLWD and/or WWD if 75 new production wells are installed. These wells would be installed on the west side of the valley and completed in the lower aquifer system beneath the Corcoran Clay, due to poor water quality in the upper aquifer. As discussed in Section 3.4.3, pumping from this aquifer system would result in subsidence due to inelastic compaction of the Corcoran Clay and silt and clay layers below the Corcoran Clay. These formations are much more susceptible to subsidence than the upper aquifer in the Mendota area.

The San Luis Canal/California Aqueduct runs through WWD. Groundwater pumping below the Corcoran Clay in this area could result in additional subsidence that may reduce freeboard in the canal to below the minimum standard set by DWR in some locations. Up to 28 feet of subsidence occurred about 10 miles southwest of Mendota near the San Luis Canal prior to 1980. It was estimated that the cost of raising the lining and levees along a 2-mile segment of the canal to restore the necessary freeboard would be $3 million (Jones and Stokes, 1995). Depending on the rate and duration of subsidence, well casings may be damaged by the resulting compressional stresses. Subsidence rates and overall magnitude caused by the well construction alternative cannot be predicted precisely, because the number, location, pumping rate, and resulting groundwater drawdown are not known at this time. Therefore, this alternative has the potential to have a significant effect on subsidence.

4.2.3 Land Fallowing

If the MPG opts to fallow land currently in production rather than acquire 25,000 acre-feet of groundwater from new wells, there would not be additional groundwater level decline that would cause subsidence. Under this option, MPG transfer pumping near Mendota Pool would not occur in the future, nor would associated subsidence in the Mendota area. No additional water would be extracted from below the Corcoran Clay in SLWD or WWD. Therefore, no increased subsidence would occur. The land fallowing alternative would result in less-than-significant subsidence.

4.2.4 Cumulative Effects on Land Subsidence

The City of Mendota's proposed groundwater extraction program would shift up to 2,400 acre-feet of pumpage from its existing well field west of the Fresno Slough to new wells installed east of the Slough at B&B Ranch. This could cause a slight decrease in subsidence west of the Slough and a slight increase in subsidence east of the Slough. Eventually, the City intends to exchange the water pumped on the B&B Ranch with water pumped into the Slough from the wells west of the Slough. This project is not expected to have a significant impact on total subsidence in the Mendota area.

Subsidence due to MPG deep-zone transfer pumping would be limited to an average of 0.005 foot per year at the extensometers located east and west of the Slough. This is in addition to subsidence caused by all other pumping activities, including non-MPG pumpage and MPG pumpage for adjacent use. Because MPG transfer pumpage is considered to be responsible for the last portion of drawdown, it is assumed to have a relatively greater effect on total subsidence. If future deep zone drawdowns cause more subsidence than anticipated, MPG transfer pumping from the deep zone would be further reduced to prevent significant subsidence from occurring. Furthermore, the annual pumping programs for the proposed action would be designed to allow recovery of groundwater levels during the winter months to the pre-irrigation season levels. This would help prevent groundwater elevations from approaching new historical low levels and would minimize the rate of subsidence on a long-term basis. Therefore, the proposed action would not contribute significantly to the cumulative effect of drawdown on subsidence.

The New Well Construction alternative has the potential to increase subsidence in SLWD and WWD, because the wells would pump groundwater from below the Corcoran Clay. Significant subsidence has already occurred in these areas due to groundwater drawdown in the lower aquifer from pumping by existing production wells. The Land Fallowing alternative would slightly reduce cumulative subsidence in the Mendota area because MPG pumping in the vicinity of the Pool would decrease. Similarly, land fallowing would not add to cumulative subsidence in SLWD or WWD.

4.3 Groundwater Quality

There has been groundwater quality degradation in the Mendota area for several decades, and water quality is already significantly degraded at some locations. Wells operated by the MPG and other entities including CCID, Firebaugh Canal Water District, and the City of Mendota have been previously removed from service as a result of water quality impacts due to the easterly movement of the saline front. Although the saline front is the primary cause of groundwater quality degradation in the Mendota area, wells operated by Spreckels Sugar Co. have been removed from service due to localized sources of contamination.

Only a few wells have long-term data sets for evaluation of historical groundwater quality changes. The CCID wells northwest of Mendota and the City of Mendota's water supply wells have the longest periods of record showing water quality changes over time. West of the Fresno Slough and the San Joaquin River, increased salinity is the principal water quality concern. Both EC and TDS data are commonly used to represent the salinity of the groundwater. EC data collected from the City's wells since about 1980 and data collected recently as part of the MPG monitoring program are discussed in Section 3.4.4. These data suggest that groundwater quality degradation is still occurring in the Mendota area, but the rate of degradation has slowed considerably in recent years.

Comprehensive monitoring of water quality has been conducted at the MPG wells and other wells in the vicinity of the Mendota Pool since 1999. Current groundwater quality, based on results of the groundwater monitoring program, was discussed in Section 3.4.4 and compared to groundwater quality criteria. The following sections evaluate the potential effects of the proposed action and alternatives on groundwater quality.

The proposed action, or an alternative, would have a significant impact on groundwater quality if the rate of water quality degradation at wells in the project vicinity increases such that the quality is no longer adequate for the beneficial uses of the water. The significance of degraded groundwater quality (such as increased salinity) depends on the use of the water. Thus, the significance of an increase in a particular parameter may be different for a potable supply well than for an irrigation well. Applicable groundwater quality criteria for protection of beneficial uses include maximum contaminant levels (MCLs) for drinking water, water quality guidelines for irrigation water as defined under California Title 19 rules and the United Nations Food and Agriculture Organization (Ayers and Westcot 1985), and water quality criteria relevant to surface water (Table 3-4).

The beneficial uses identified for the surface water body (Mendota Pool) are agricultural supply, wildlife habitat, non-contact recreation, and aquatic life. For these beneficial uses, groundwater and surface water criteria were identified for the following constituents or water quality parameters: arsenic, boron, molybdenum, selenium, and salinity (as TDS, EC, and SAR). Potential effects on surface water quality due to introduction of groundwater into the Pool are discussed in Section 4.4.

4.3.1 Estimation Of Effects On Groundwater Quality

A groundwater quality model has been developed to assess the effect of the proposed action on groundwater quality in the vicinity of the Pool over the 10-year duration of the project. The model simulates water quality degradation in the Mendota area due to different causes. Factors such as the regional gradient and non-transfer pumping are independent of the proposed action and alternatives, but also influence the rate of groundwater quality degradation. Application of the groundwater quality model has emphasized prediction of water quality impacts due to migration of the saline front. The model has also been used to assess water quality impacts due to other sources of degradation, including migration of wastewater beneath the Spreckels Sugar Co. property and the City of Mendota sewage treatment ponds.

The groundwater quality model uses gradients based on drawdowns calculated with the groundwater flow model discussed in Section 4.1 to predict the migration rate of saline groundwater. The output from the groundwater quality model is incorporated into the surface water mixing model described below and used to develop MPG pumping programs for the 10-year project that meet surface water quality standards. A flowchart showing the interactive application of the three models is shown on Figure 4-3. Detailed discussions of these models are provided in Appendix D.

The focus of the groundwater quality modeling is on the prediction of changes in salinity (measured as TDS) over time, because salinity is considered the most critical factor affecting groundwater quality in the Mendota area. Since salinity is measured in some form in almost all groundwater quality samples, there are sufficient data to estimate degradation rates for salinity at a number of wells near the Pool. Because data for trace elements such as arsenic, boron, molybdenum, and selenium are much more limited, determination of degradation rates based on these constituents is generally not possible. These constituents would continue to be included in sampling conducted as part of the groundwater and surface water monitoring programs to ensure that they do not exceed water quality standards.

4.3.1.1 Groundwater Quality Model

A groundwater quality model was developed to predict changes in water quality (specifically salinity concentrations) in the shallow and deep zones at MPG wells and other wells (e.g., CCID and City of Mendota) that extract groundwater in the vicinity of the Fresno Slough branch of the Mendota Pool. This model predicts changes in groundwater quality due to easterly movement of the saline front resulting from increased groundwater gradients caused by pumping. Water quality changes due to groundwater pumping, the regional gradient, and recharge from the Pool are simulated with the model in order to determine the cumulative impact. The cumulative amount of degradation with and without MPG transfer pumping are simulated separately, so that the impacts of the proposed action can be calculated by subtraction. The model uses TDS concentrations to represent the salinity of the groundwater. Although ion exchange processes may result in individual ion concentration differences, the total salts dissolved in groundwater are not significantly retarded due to processes such as sorption by clays or other aquifer materials. Therefore, the total dissolved solids are generally considered to move at the same rate as the groundwater. The model also includes dilution of the saline groundwater due to recharge from the Pool and inflow of less saline groundwater from downgradient and cross-gradient directions.

Degradation due to movement of the saline front primarily affects wells west of the Fresno Slough (south of Mendota Dam) and west of the San Joaquin River (north of Mendota Dam). The eastern portion of the study area generally has much better water quality due to good quality recharge from the San Joaquin River and geologic factors. Wells east of the Fresno Slough, such as the FWD and NLF wells, have not shown signs of water quality degradation due to MPG pumping. Therefore, degradation in wells east of the Fresno Slough is not simulated, except for the five shallow MPG wells near Whites Bridge (the Coelho West wells). For these wells, the model also simulates degradation due to southwesterly migration of wastewater from Spreckels Sugar Co. The groundwater quality model was calibrated using

TDS data collected over a 4-year period (1999-2002). The development and calibration of the model are discussed in Appendix D.3.

4.3.1.2 Surface Water Mixing Models

Two surface water mixing models were developed in 2001, one for the southern portion of the Fresno Slough (the MWA) and one for the San Joaquin River branch of the Pool (east of the CCID Main Canal). Both models are used to predict TDS and boron concentrations in these areas. The model for the southern Fresno Slough was developed to predict surface water quality changes south of Whites Bridge Road caused by MPG pumping and to ensure that the surface water quality in the MWA meets applicable water quality criteria. It incorporates well-by-well pumpage and water quality data and was used to develop MPG pumping programs for 2002 that would not cause significant surface water quality impacts. For the 10-year proposed action, this model was used to develop a transfer pumping program for each year of the project that does not cause surface water quality targets in the MWA (Table 3-4) to be exceeded.

Since the DMC supplies most of the water delivered via the Mendota Pool, the surface water quality model for the MWA uses the monthly average EC measurements at the DMC terminus for the last 10 years (January 1993 through October 2002) to estimate the ambient TDS concentration in the Pool (without MPG pumping). This period was selected for two reasons:

- The quantity and quality of the DMC inflow has changed considerably in recent years due to several factors, especially CVPIA. This law was enacted in October 1992 and implementation began in 1993.

- Measurement of EC at Bass Avenue near the DMC terminus (Check 21) began in January 1993. Earlier DMC water quality data are from Check 20, located 6 miles upstream. Both Check 20 and Check 21 are downstream of the sump inputs.

The TDS model for the MWA incorporates: (1) the volume of DMC water available for mixing based on the water budget for the southern portion of the Pool; (2) initial TDS data for the MPG production wells based on the most recent sampling results and the groundwater quality model discussed above; and (3) the calculation of salinity concentrations due to MPG pumping for adjacent use, in addition to transfer pumpage, so that the cumulative impact can be determined. The latter makes it possible to use the model to predict the TDS concentration in the MWA on an average monthly basis as well as the concentration increment resulting from MPG transfer pumping. A check of the model results against observed data from the 2001 monitoring program is summarized in the 2001 EA (Reclamation 2001).

The second mixing model was developed to calculate TDS and boron concentrations at Mendota Dam, in the San Joaquin River branch of the Pool. The TDS and boron concentrations of the MPG wells in FWD are similar to or lower than that of the DMC inflow; therefore, transfer pumping from these wells is not expected to adversely impact water quality in the this branch of the Pool. This mixing model calculates the TDS and boron concentration based on a water budget for the portion of the Pool east of the CCID Main

Canal. Similar to the TDS mixing model for the southern portion of the Slough, the San Joaquin River mixing model incorporates monthly average EC data for the DMC as discussed above, and individual pumpage and TDS contributions from the MPG wells in FWD.

Since groundwater quality data do not indicate that degradation is occurring in the FWD wells, the results of the San Joaquin River branch model were assumed to be constant during the 10-year proposed action. Water quality effects in the northern Pool due to MPG pumping are expected to change only slightly due to annual variations in the volume of transfer pumpage from the FWD wells.

Predicted TDS used in the surface water mixing models for the 10-year proposed action would be updated annually with analytical results from the groundwater sampling program. Additionally, the most current analytical results for boron and other trace elements would be used in the models so that concentrations of these constituents in surface water can be predicted accurately. The transfer pumping program would be modified annually as necessary to ensure that applicable water quality criteria would be met.

4.3.1.3 Analytical Approach

Because of the adaptive management approach to maintaining surface water quality required as part of the 10-year program, the modeling approach is based on the assumption that modifications to the MPG transfer pumping program would be made on an annual basis. Therefore, the three models (the groundwater flow and quality models and the surface water mixing model) were applied in an iterative fashion that allowed for modifications to the pumping programs for each year of the proposed action based on predictions of groundwater quality at the end of the previous year and surface water quality during the year (Figure 4-3). These models cannot account for other factors such as abandonment or construction of wells or the effects of other pumping activities; the results presented herein are only best estimates of the potential level of effect.

At the initiation of the modeling effort, a pumping program was designed that achieved the required surface water quality in the southern portion of the Pool. The effects of this pumping program on drawdown and the groundwater gradient were then simulated using the groundwater flow model discussed in Section 4.1 and Appendix D.1. The groundwater quality model was then used to estimate the change in groundwater quality over the one year period. Next, the output from the groundwater quality model was incorporated into the surface water mixing model for the following year to determine whether the proposed pumping program would violate any surface water quality criteria at the MWA. As necessary, the simulated transfer pumpage was redistributed or reduced so that surface water quality standards would not be exceeded. This process was repeated for each of the 10 years. Years 1 and 6 of the project were assumed to be “wet” years during which no transfer pumping was conducted. The other eight years were treated as normal years (maximum of 31,600 acre-feet of transfer pumpage), because the model results indicate that it would be difficult for the MPG to pump more than 31,600 acre-feet in dry years without causing surface water quality impacts. This could change in the future if the actual salinity of the groundwater or the DMC inflow are better than the assumptions used in the model. MPG pumping for adjacent use was assumed to be constant (14,000 acre-feet/year) during each of the ten years.

4.3.2 PROPOSED ACTION

MPG pumping as specified in the proposed action would contribute to groundwater quality degradation primarily as a result of the following three factors:

1. Pumping of MPG wells along the Fresno Slough (especially deep wells) creates a steeper horizontal gradient, which accelerates the lateral flow of groundwater west of the Slough toward the MPG well field. The northeasterly gradient exists both with and without MPG pumping, however the pumping steepens the gradient and increases the rate of flow from the west and southwest.

2. Pumping of deep MPG wells along the Fresno Slough would increase vertical (downward) gradients. This would accelerate the downward flow of groundwater through the A-clay to the deeper water-bearing zones of the upper aquifer system. Near both branches of the Pool, the quality of the shallow groundwater is good due to recharge from the Pool. In areas west of the Slough, however, the quality of the shallow groundwater is poor, and this downward flow increases water quality degradation below the A-clay.

3. Pumping of MPG wells (especially shallow wells along Fresno Slough) removes some of the good quality groundwater that originates as seepage from the Pool. In the absence of MPG pumping, the seepage from the Pool would help maintain water levels in the shallow, unconfined aquifer above the A-clay, improve groundwater quality near the Pool, and counteract some of the degradation caused by lateral flow of lower quality groundwater from the west.

Deep zone transfer pumping would be conducted primarily in the spring and fall so as not to increase the maximum drawdown in the area, which typically occurs during the peak of the irrigation season (July or August). The effect of this action would be to mitigate increases in the horizontal and vertical gradients in the deep zone, which would slow the rate of salinity increases in the groundwater.

4.3.2.1 Effects on MPG Wells

An increased rate of groundwater quality degradation due to the proposed action was predicted at all MPG wells along the Fresno Slough with the groundwater quality model. At the start of the 10-year simulation, 66 wells were included in the MPG pumping programs for transfer or adjacent use. A total of 26 MPG wells were not included in the 10-year pumping program for various reasons, including18 wells excluded from future pumping programs due to poor water quality. Over the future 10-year project period, only one additional well was removed from the pumping program because it was predicted to exceed the TDS constraint of 2,000 mg/L (see Section 2.1.1.). Estimated pumpage from other wells was reduced, especially during the fall, to maintain surface water quality. Another MPG well (Meyers Farming MS-5) was predicted to exceed the 2,000 mg/L TDS limit before the end of the 10-

year project, but this well is only pumped for adjacent use and can be operated without using the Pool for conveyance.

The simulated MPG pumpage for each year of the 10-year project period is summarized in Table 4-1. Currently, the total amount of groundwater that could be pumped for transfer without violating surface water quality criteria at MWA is approximately 31,600 acre-feet. In the second year of the proposed action, this amount would decrease to about 31,100 acre-feet due to predicted groundwater quality degradation. The simulated transfer pumpage was subsequently reduced each year to approximately 28,500 acre-feet during the last three years of the 10-year project. The simulated transfer pumpage during the eight normal and dry years averages about 29,600 acre-feet per year.

The impact of MPG transfer pumpage on groundwater quality degradation in MPG wells scheduled to be pumped for transfer or adjacent use during the 10-year project is summarized on Table 4-2 (shallow zone) and Table 4-3 (deep zone). Table 4-3 also shows deep non-MPG production wells west of the Fresno Slough, which were pumped in 2001 or 2002 and are close enough to the MPG wells to potentially be impacted by transfer pumping. Table 4-2 does not show any shallow non-MPG wells, because all non-MPG production wells near the Fresno Slough are deep wells. These tables show the predicted average annual TDS increase over the 10-year period due to the regional gradient, non-transfer pumpage, and transfer pumpage. The predicted cumulative degradation rate is the sum of these TDS increases.

The total simulated TDS change reflects the net effect of processes that have the tendency to either degrade or improve groundwater quality. The model results summarized in Table 4-2 indicate that a number of shallow MPG wells would experience water quality improvements in the absence of all pumping. This is indicated by negative values in the column showing the effect of the regional gradient on TDS. The negative values are due to the fact that the regional gradient is relatively flat in the shallow zone, and the resulting inflow of saline groundwater from the west is offset by recharge of good quality water from the Pool. The negative values in Table 4-2 associated with the regional gradient reflect factors in the model that account for this recharge and also cross-gradient flow to wells located near the Fresno Slough. At locations further from the Slough, water quality improvements would not be expected to occur. Water quality improvements are also not predicted in the deep zone, where the regional gradient is steeper and there is less recharge from the Pool.

As shown on Table 4-2, the average predicted annual TDS increase due to transfer pumpage at the shallow MPG wells ranges from 13 to 43 mg/L, and for all wells the annual average was 27 mg/L per year. Wells in the southern half of the MPG well field along the Fresno Slough generally had higher degradation rates than wells located further north. In the northern Fresno Slough area, four wells (shown in **bold** on Table 4-2) had higher initial TDS concentrations and slightly higher degradation rates than other wells in this area due to wastewater from the City's sewage treatment ponds and the Fresno County waste disposal site. Similarly, three of the Coelho West wells near Whites Bridge had higher initial concentrations and higher degradation rates than other wells in this cluster due to wastewater from Spreckels Sugar Co. The TDS increases at the remaining shallow wells were assumed to be due only to easterly movement of the saline front. For most of the shallow MPG wells, degradation is only predicted to occur during normal and dry years. The model results indicate that stable or improved groundwater quality would occur during non-pumping years due primarily to good quality recharge from the Pool.

The model results (Table 4-2) show that the majority of the predicted groundwater quality degradation at the shallow MPG wells is caused by MPG transfer pumping. On a percentage basis, the calculated impact of transfer pumping ranges from 57 to 100 percent, with smaller percentages occurring in wells that pump for adjacent use. The results indicate that all of the degradation would be caused by transfer pumping at more than half of the wells, partly because the percentages calculated by the model do not account for the source of degradation. Therefore, this list includes the four wells in the Northern Fresno Slough area which are impacted by wastewater from the City's sewage treatment ponds or the Fresno County waste disposal site and three wells in the Southern Fresno Slough which are impacted by wastewater from Spreckels Sugar Co.

The predicted salinity increase at the shallow MPG wells during the proposed action is considered a significant impact. However, there are no shallow non-MPG wells in the vicinity that could be impacted. Therefore, this degradation would effect only MPG wells. As discussed in Section 4.3.3, some of this impact is expected to be offset by water quality improvements at the conclusion of the project.

Nine deep MPG production wells west of the Fresno Slough are scheduled to pump for either transfer or adjacent use during the 10-year project (Table 4-3). The other deep wells in this area have either been removed from the pumping program due to poor water quality or are not included in the 10-year pumping program because the deep MPG wells in FWD have sufficient capacity and better water quality. Predicted groundwater quality degradation in the deep wells is generally larger than in shallow wells because: 1) the regional gradient is steeper in the deep zone, and 2) the deep zone receives much less good quality recharge from the Pool. Although the overall degradation rate in the deep zone is larger, the amount of degradation predicted to be caused by transfer pumping is much smaller. The predicted average annual TDS increase due to transfer pumpage at the deep MPG wells ranges from 1 to 8 mg/L per year and averages 3 mg/L per year (Table 4-3).

As discussed above, transfer pumping from the deep wells would occur primarily in the spring and fall. For this reason, and because the total volume of MPG transfer pumpage is limited to 12,000 acre-feet per year, deep zone transfer pumpage has a much smaller effect on the degradation rate than non-transfer pumpage. For the deep MPG wells, the predicted impact of the proposed action on groundwater quality is considered less-than-significant.

4.3.2.2 Effects on Non-MPG Wells

Several deep non-MPG production wells west of the Fresno Slough are close enough to the MPG wells to potentially experience groundwater quality impacts due to transfer pumping. These include two CCID wells, two Locke Ranch wells, three City of Mendota wells, and the Mendota Biomass well.

As discussed in Section 3.4.5, historical water quality data are available for the CCID and City of Mendota wells. Degradation of water quality in these wells was observed prior to initiation of MPG pumping. MPG project pumping, such as it contributes to additional drawdown and increased groundwater gradients, would contribute to future degradation. The predicted overall rate of water quality degradation is highest in the westernmost wells (CCID well No. 32B and City wells Nos. 3 and 4). The model results indicate that only a small amount of the annual degradation at these wells would be caused by MPG transfer pumping. There are two primary reasons for this: 1) these wells are located generally cross-gradient to the northern MPG wells, and 2) most of the pumpage from the MPG well field along the Fresno Slough is from shallow wells.

Model results indicate that annual TDS increases of about 1 mg/L per year are predicted at CCID wells No. 5A and 32B due to MPG transfer pumping (Table 4-3). This represents 2 to 3 percent of the total TDS increase predicted at these wells. The Locke Ranch wells are not included in the simulation because water quality and pumpage data were not available for these wells. Degradation at the Locke Ranch wells is expected to be similar to the CCID wells. City of Mendota wells No. 3, 4, and 5 are closer to the MPG wells, and the predicted annual TDS increase due to MPG transfer pumping is 3 mg/L per year at these wells. This represents 5 to 6 percent of the total predicted TDS increase at the City's wells. City wells Nos. 2 and 6 were not included in the simulations because they are not used for water supply. MPG transfer pumping is not expected to have an impact on water quality at the three new City wells east of the Fresno Slough (Nos. 7, 8, and 9). The Mendota Biomass well, which is located near the center of the MPG well field west of the Fresno Slough, is also predicted to experience a slightly increased rate of groundwater quality degradation due to MPG transfer pumping. The proposed action is predicted to cause an average annual TDS increase of 2 mg/L (6 percent of the total) at this well. Since the applicable water quality criteria would not be exceeded and the beneficial use would not be impaired, the effect of the project on this well and other non-MPG wells is considered less-than-significant.

4.3.3 NEW WELL CONSTRUCTION

Under this alternative, up to 25,000 acre-feet per year would be pumped from new wells in WWD and SLWD to compensate for the water that would have been provided through the exchange with Reclamation. These wells would be constructed on MPG lands in WWD and SLWD and would likely be perforated in the lower aquifer (below the Corcoran Clay), because the upper aquifer generally has poor water quality in this area. The Corcoran Clay acts as a relatively effective barrier to vertical flow between the upper and lower aquifers. The Corcoran Clay's effectiveness as a confining layer is due to its thickness, low permeability, and because it is continuous throughout most of this area. These factors would be expected to prevent significant downward flow of poor quality groundwater due to the increased pumping below the Corcoran Clay. Therefore, this alternative is not anticipated to significantly affect groundwater quality in WWD or SLWD.

4.3.4 LAND FALLOWING

This alternative would have less effect on groundwater quality in the vicinity of Mendota Pool than the proposed action and no effect in WWD and SLWD. Up to 9,000 acre-feet of water may be pumped from the MPG wells into the Mendota Pool for transfer or exchange with other users around the Pool as part of this alternative. This would probably cause additional groundwater quality degradation at some wells near the Pool, but the impact would be less than the proposed action. However, an equivalent amount of water may be pumped by the other users if it was not available from the MPG. This would likely cause water quality impacts in other areas.

4.3.5 Cumulative Effects on Groundwater Quality

Pumping activities near the Mendota Pool (by the MPG and other pumpers including CCID, Locke Ranch, the City of Mendota, and Mendota Biomass) contribute to groundwater drawdowns and increase the rate at which the saline front moves toward the Pool from the west and southwest. In the absence of any pumping near the Mendota Pool, groundwater would continue to flow in a northeasterly direction as a result of the regional gradient. As a result, groundwater would continue to degrade in this area due to naturally occurring poor quality groundwater west of the Fresno Slough. The groundwater quality model simulates salinity increases due to movement of the saline front caused by the regional gradient, transfer pumping, and non-transfer pumping.

The model also simulates degradation due to migration of wastewater-affected shallow groundwater beneath the City's sewage treatment ponds and Fresno County waste disposal site in the northern portion of the Fresno Slough and the Spreckels Sugar Co. area east of the Slough. Degradation due to the City of Mendota and Fresno County facilities appears to be localized, but degradation due to Spreckels Sugar Co. wastewater covers a large area beneath the Spreckels' property east of the Fresno Slough, especially where the wastewater has been used to irrigate permanent pasture in the western and southern portions of the Spreckels' property. Offsite migration of percolated wastewater toward the shallow MPG wells near Whites Bridge occurs when these wells are pumped. In the eastern portion of the Spreckels factory, some of the degraded groundwater has moved downward to the deep zone and has migrated offsite in a northerly direction toward wells in the southern portion of FWD. The deep zone migration is not simulated with the model, because degradation at the southern FWD wells has been minimal so far.

Other influences on groundwater quality which are not simulated with the model include deep percolation of applied irrigation water, which causes long-term water quality degradation, primarily in the shallow zone. Near the Fresno Slough and the San Joaquin River, this degradation is offset by good quality surface water recharge. In the Spreckels Sugar Co. area, some of the degradation caused by deep percolation of Spreckels' wastewater would be offset by good quality recharge from the Meyers Farm Water Bank, which is being developed in the western portion of the Spreckels Sugar Co. property. This project pumps water from the Pool into infiltration ponds for recharge to the shallow aquifer east of the Fresno Slough. Extraction wells would be installed near the ponds in the future to withdraw water from the bank, but five percent of the banked water would remain in the aquifer and would result in long-term water quality improvements.

Groundwater pumping and the associated movement of the saline front remains the largest factor in groundwater quality degradation in the Mendota area. In addition to transfer pumpage, the estimated non-transfer pumpage within the study area (except for pumpage from domestic wells) is simulated with the model. In 2001, the total non-MPG pumpage was estimated to be about 143,600 acre-feet, and MPG pumpage for adjacent use was about 13,300 acre-feet (LSCE and KDSA, 2002). For simulations of the 10-year project period, the non-MPG pumpage was held constant at the 2001 levels, and MPG pumpage for adjacent use was assumed to be 14,000 acre-feet/year as allowed under the Settlement Agreement. Proposed MPG pumpage for adjacent use in 2003 is shown in Table 2-4, and pumpage during the other nine years was assumed to be similar for modeling purposes.

Groundwater quality degradation in the shallow zone predicted to occur during the 10-year project period is shown on Table 4-2. Because the MPG wells are the only shallow production wells in the Mendota area, all degradation due to non-transfer pumpage shown on this table results from MPG pumpage for adjacent use. Since the majority of the shallow MPG wells are used exclusively for transfer pumping, non-transfer pumping represents a small portion of the total degradation. At most wells that are only pumped for transfer, the model predicts relatively stable or improved water quality in the absence of transfer pumping. This occurs because good quality recharge from the Pool is predicted to have a greater effect on groundwater quality at shallow wells near the Pool than the regional gradient. Therefore, the simulated impact due to all pumping is smaller than the impact due to transfer pumping at these wells. The predicted average annual TDS increase due to all shallow pumpage and other factors (the cumulative impact) ranges from 11 to 36 mg/L per year. Over the 10-year period of the proposed action, the TDS increase at these wells is predicted to range from 106 to 357 mg/L. This is considered to be a significant impact. At the conclusion of the project, however, substantial water quality improvements are expected in the shallow zone due to surface water recharge. These would offset some of the degradation that is predicted to occur during the project.

The average annual TDS increase predicted to occur during the 10-year project period due to non-transfer pumping in the deep zone is shown on Table 4-3. In the deep zone, the regional gradient is steeper and has a greater effect on the degradation rate. There is also less dilution of saline groundwater due to recharge from the Pool. Because MPG transfer pumpage represents a small percentage of the total deep zone pumpage, most of the predicted degradation in the deep zone is due to the regional gradient and non-transfer pumpage. The simulated cumulative average annual TDS increase ranges from 26 to 66 mg/L per year. As discussed above, three wells north of Mendota (CCID well No. 32B and City wells Nos. 3 and 4) are predicted to have the highest degradation rates because of their locations relative to the saline front. At these and other non-MPG wells, the model results indicate that easterly flow of saline groundwater flow due to the regional gradient and non-transfer pumping is responsible all but 2 to 6 percent of the predicted water quality degradation. Over the 10-year period of the proposed action, the cumulative TDS increase at the non-MPG wells is predicted to range from 301 to 655 mg/L. Although only a small percentage of this predicted degradation is due to the proposed action, the cumulative impact is considered significant and would occur in the absence of MPG transfer pumping. At the MPG wells, groundwater flow due to the regional gradient and non-transfer pumping is also responsible for most of the predicted degradation (77 to 96 percent). The cumulative TDS increase at these wells is predicted to range from 259 to 403 mg/L. This is also considered a significant cumulative impact.

The long-term water quality monitoring program for MPG wells described in Appendix B would be continued throughout the 10-year proposed action. In 2002, the groundwater quality monitoring program included 49 MPG wells and 84 wells owned by other area entities. MPG wells would be removed from future pumping programs if groundwater quality changes during the project result in exceedance of the 2,000 mg/L TDS limit.

4.4 SURFACE WATER QUALITY

The proposed action, or an alternative, would be considered to have a significant impact on surface water quality if it would degrade the quality of water bodies in the project vicinity such that they no longer meet their beneficial uses as measured by exceedances of applicable water quality criteria (Table 3-4). The significance of changes in surface water quality (such as an increase in salinity) depends on the use of the water. In the case of the Mendota Pool, these beneficial uses include irrigation water, wildlife habitat, and protection of aquatic life. Potential indirect effects of changes in water quality in Mendota Pool include: 1) water diverted from the Pool for irrigation purposes could exceed recommended constituent levels or contribute to the frequency, magnitude, or duration of violations of numerical water quality criteria established in the Basin Plan for the Sacramento River and the San Joaquin River Basins (CVRWQCB 1988), 2) water diverted from the Pool for irrigation purposes could contribute to exceedances of water quality standards for TDS in agricultural return drainage flows, 3) salt and boron loads to the San Joaquin River below Mendota Dam could increase and the TMDLs for these constituents could be exceeded, and 4) water diverted from the Pool could contribute to exceedances of refuge water quality criteria in the MWA. The State Water Resources Control Board has recently (February 4, 2003) approved the "2002 CWA Section 303(d) List of Water Quality Limited Segment". This list, although not yet accepted by USEPA, identifies the Mendota Pool as impaired due to selenium.

Surface water quality criteria or guidelines were identified for constituents or water quality parameters of concern: arsenic, boron, molybdenum, selenium, and salinity (as TDS and EC). The criteria are summarized in Table 3-4 and current conditions in Mendota Pool are discussed in Section 3.3.2. Compliance with these surface water criteria protects the beneficial uses of surface water including irrigation water, wildlife refuge habitat, and aquatic life. Predictive models describing surface water mixing are summarized in Section 4.3.1.2 and in Appendix D.4. These models are used to estimate the effect of MPG pumping programs on surface water quality, and in the development of pumping programs.

4.4.1 PROPOSED ACTION

The proposed action includes several design constraints (see Section 2.1.1) that limit impacts to surface water quality, primarily as related to salinity. As discussed in the previous section, these design criteria were used to ensure that surface water quality did not exceed guidelines for the MWA due to the proposed action. The planned quantity and quality of groundwater pumped into the Pool would be adjusted during each year of the proposed action to ensure that the surface water quality criteria for salinity and trace elements (arsenic, boron, molybdenum, and selenium) would be met.

The surface water mixing models introduced in Section 4.3 would be used in conjunction with annually updated analytical results from groundwater samples to facilitate the decision making process regarding annual adjustments to the pumping program. Likewise, the measured water quality of the DMC and the San Joaquin River used in the mixing models would be updated as appropriate. By updating the models as new surface water and groundwater data become available, the MPG annual pumping program would be designed to protect water quality at the MWA and northern portion of Mendota Pool throughout the 10-year duration of the proposed action.

The following discussion summarizes overall water quality relative to water quality criteria for beneficial uses.

4.4.1.1 Trace Elements

As discussed in Section 3.4.5, arsenic was detected in only a few pumping wells and is present at levels lower than the lowest criterion identified for a beneficial use of Pool water (Refuge Water Supply). Therefore, the pumping program is not likely to result in exceedances of applicable water quality criteria for arsenic in the short term. The groundwater and surface water monitoring program would track changes in arsenic concentrations to ensure that surface water quality criteria are not exceeded in the future. The proposed action would not have an adverse effect on arsenic concentrations in the Mendota Pool.

Boron was detected in all wells tested. Boron levels in many of the MPG production wells along the Fresno Slough are 0.3 mg/L or higher; and concentrations in 16 wells exceed the CDFG unacceptable level of 0.6 mg/L. However, wells with the highest boron concentrations are either excluded from the proposed action due to high TDS levels or would only be pumped for a limited time each year because of TDS levels greater than 1,200 mg/L. The average boron concentration in MPG wells along the Fresno Slough included in the transfer pumping program is 0.4 mg/L. The MPG wells along the San Joaquin River have much lower boron concentrations than wells along the Fresno Slough, with most concentrations less than 0.2 mg/L.

A number of surface water samples for boron collected since January 2001 (13 of 43 analyses) in the southern Fresno Slough (Mendota Wildlife Area, Lateral 6 & 7, and James ID, and Tranquillity ID) exceeded 0.3 mg/L, which is the target level recommended by CDFG for boron for the Mendota Wildlife Area. Only one surface water sample tested for boron in 2002 exceeded 0.3 mg/L. The exceedance occurred in the June 2002 sample from Tranquillity ID. The measured concentrations in these southern Pool locations are probably due to inputs from sources other than the MPG production wells. CDFG considers a concentration of 0.6 mg/L to represent unacceptable (toxic) concentrations in surface water. The boron concentrations recommended by CDFG are based on the water quality standards for the San Joaquin River at Vernalis and are below the criteria for other identified uses of the Pool water. The results of mixing models developed to predict boron concentrations in the southern Fresno Slough and the San Joaquin River branch are discussed in the following sections.

Molybdenum concentrations in all MPG wells included in the transfer pumping program are below the lowest applicable water quality criterion of 10 μg/L. Therefore, the pumping program is not likely to result in exceedances of surface water quality criteria for molybdenum in the short term. The groundwater and surface water monitoring program would track changes in molybdenum concentrations to ensure that surface water quality criteria are not exceeded in the future. The proposed action would not have an adverse effect on molybdenum concentrations in the Mendota Pool.

Data collected at nine surface water sample locations indicate that molybdenum levels in the Pool were 10 μg/L or less. These concentrations are much lower than the criterion for aquatic life protection of 19 μg/L. However, the highest detected level, 10 μg/L, is at the target level recommended by CDFG for the Mendota Wildlife Area. The MPG pumping program is unlikely to be the source of elevated molybdenum concentrations due to low concentrations in the wells.

Selenium is generally not present at detectable levels (i.e., <0.4 μg/l) in shallow or deep MPG production wells along either arm of the Pool. Selenium was detected in only three MPG production wells in 2001 or 2002, and all concentrations were less than 1 μg/L. Therefore, MPG pumping would not contribute to exceedances of water quality criteria for selenium in the short term. Design constraints for the transfer pumping program do not allow pumping from any wells with selenium concentrations greater than 2 μg/L. Since selenium is not generally detected in MPG well water, the proposed project will not effect the TMDL analysis.

Selenium is present at low concentrations in Mendota Pool surface water samples collected in 2001, with the lowest levels seen in samples from the Mendota Wildlife Area, the Lateral 6 & 7 intake, and James ID. The highest selenium levels reported in 2001 were detected in the March and April samples from the northern portion of the Fresno Slough. Detected levels at all locations are an order of magnitude lower than drinking and irrigation water criteria of 50 μg/L. The criterion for protection of aquatic life and the CDFG recommended target level for the MWA are both 2 μg/L. Selenium concentrations in the southern Fresno Slough do not exceed this target level. The proposed action will have a less-than-significant effect on selenium concentrations in Mendota Pool.

4.4.1.2 Salinity (as TDS)

TDS concentrations in the Pool (either measured directly or estimated from EC data) vary widely, with the highest concentrations seen in samples collected from the southern portion of the Pool. The TDS concentrations are related to the concentrations in the DMC (Figure 3-8 and Figure 3-9) and inputs from the MPG wells. Predicted TDS concentrations in the southern and northern portions of the Pool (the MWA and Mendota Dam, respectively) would be calculated prior to each pumping season using surface water mixing models. The models are described in detail in Appendix D.4 and summarized in Section 4.3.

Specified design constraints that would be incorporated into each annual pumping program under the proposed action include basing the selection of MPG wells to be pumped each month on water quality criteria and eliminating all pumping from wells with TDS concentrations greater than 2,000 mg/L. During the fall, when water quality at the MWA is most critical, wells with TDS higher than 1,200 mg/L would not be pumped for transfer. Projected MPG pumping for adjacent use is also included in the surface water quality model for the MWA. The salinity at the MWA predicted by the TDS model would be checked against results from grab samples collected on a monthly basis and against continuous data from the EC recorder in the MWA. Results of the TDS mixing model developed for the San Joaquin River branch of the Pool would also be checked against grab sample and continuous EC data.

The surface water mixing models would be updated each year as new surface and groundwater data are obtained, and the pumping program would be adjusted to minimize salinity impacts. Selection of the wells to be pumped for transfer each year would be based on groundwater quality in order to limit the total mass of salt introduced into the Pool. This would have a corresponding effect on concentrations of specific constituents such as chloride and sulfate. The potential effects on surface water quality from the proposed action due to TDS, chloride, and sulfate would be minimized due to pumping program design constraints and groundwater and surface water quality data provided by the monitoring program and used in the design of the transfer pumping program.

4.4.1.3 Potential for Effects in Northern Fresno Slough

The water quality in the northern Fresno Slough is primarily influenced by the quality of the water that is introduced by the DMC. Design constraints have been implemented to preclude the MPG wells along the Fresno Slough from influencing water quality in the northern Slough. The MPG has agreed to cease pumping into the Slough when flow in the Slough is to the north, or when EC concentrations at the Exchange Contractors' canal intakes exceed concentrations in the DMC by 90 μmhos/cm or more for a period of three consecutive days.

Water from the northern portion of the Pool is used to irrigate lands to the north of the Pool, and to provide flow in the Grasslands watershed. Water from these practices is returned to the San Joaquin River below Mud Slough. Due to the design constraints, MPG pumpage would not alter the water quality conveyed to these lands. Therefore, MPG pumpage would not introduce additional salts, boron, or selenium into the lower San Joaquin River, thereby affecting the TMDLs for these constituents. Similarly, MPG pumpage would not cause irrigation return flows from the lands north of the Pool to exceed applicable water quality criteria for irrigation return flows.

4.4.1.4 Potential for Effects in Southern Fresno Slough

Table 4-4 shows the predicted effect of the proposed action and the cumulative effect during the first pumping year (Year 2 of the project) and the final (tenth) year on TDS concentrations. These results account for the predicted groundwater quality degradation and associated modifications to the pumping program. The model indicates that transfer pumpage would result in an average TDS increase during the pumping months of 96 mg/L in Year 2 and 109 mg/L in Year 10 of the proposed action. The predicted TDS increase due to pumping for adjacent use and the total predicted concentration are discussed in Section 4.4.4 (Cumulative Effects).

The results of a similar surface water mixing model for boron are summarized on Table 4-5. The ambient boron concentrations shown on this table are based primarily on grab samples collected in the DMC during 2002. The monthly boron concentrations in water from the MPG wells are based on the most current sampling data available for each well included in the proposed 2004 pumping program. The boron concentrations in the MPG wells along the Fresno Slough are generally low, but on average are slightly higher than the concentrations in the DMC inflow. The model results indicate that MPG transfer pumpage would result in an average boron concentration increase of 0.04 mg/L during the months that this pumpage would occur (March through November).

Water users taking water from the southern portion of the Fresno Slough do not have facilities for returning drain water to the San Joaquin River or to other surface water bodies that drain to the San Joaquin River. Therefore, pumping of groundwater into the Fresno Slough branch by the MPG would not result in increased TDS or boron concentrations in surface water due to irrigation return flows. There would be no exceedances of TMDLs for those constituents for the San Joaquin River due to the proposed action.

The pumping program design constraints and monitoring program effectively mitigate potential effects on surface water quality in the southern Fresno Slough. Therefore, the proposed project will have a less-than-significant effect on surface water quality in the southern Fresno Slough.

4.4.1.5 Potential for Effects in the San Joaquin River Branch

Groundwater quality in MPG production wells within FWD meets the water quality objectives for the San Joaquin River at Vernalis as identified in the Basin Plan for salinity (TDS), boron, and selenium (Table 3-4). As discussed in Section 4.3.1.2, a mixing model for the San Joaquin River branch of the Pool was developed to quantify the effect of the project on TDS concentrations at Mendota Dam. The model results for Year 2 of the proposed action are shown in Table 4-6. Because the water quality in this branch of the Pool is highly dependent of the amount of San Joaquin River inflow, two different scenarios were considered. The first is based on the moderate amount of San Joaquin River inflow that occurred in 1999 and 2000. The second scenario is based on the low San Joaquin River inflow that occurred in 2001 and 2002. For both scenarios, the model results indicate that MPG transfer pumping would have no impact on water quality in this branch of the Pool. This is primarily due to the fact that the water quality of the FWD wells is generally similar to that of the DMC. Furthermore, the volume of water introduced by the MPG (about 10,000 af) constitutes less than 5 percent of the total volume of water conveyed through this portion of the Pool. Because water quality degradation has not been observed in samples from the FWD wells, the predicted TDS concentrations are assumed to be constant during the remainder of the 10-year proposed action.

A similar mixing model was developed to predict boron concentrations in the San Joaquin River branch of the Pool. The results of this model for moderate and low flow conditions in the San Joaquin River are shown on Table 4-7. Because wells in FWD have generally lower boron concentrations than DMC water, the model results indicate that water from the MPG wells would also have no impact on boron concentrations in this branch of the Pool. Since the 1999-2002 water quality data indicated stable or decreasing boron concentrations in FWD wells, the predicted boron concentration calculated by the mixing model were also assumed to remain constant during the 10-year proposed action.

If TDS or boron concentrations in the FWD wells change during the course of the project, the model results would be updated and adjustments to the pumping program would be made to ensure that no significant impacts occur. Therefore, the proposed action would have no effect on salinity and boron concentrations in the northern Pool.

4.4.1.6 Summary

The pumping program design constraints and adaptive management measures described in the preceding sections would effectively mitigate the effect of the proposed action on surface water quality in Mendota Pool. The surface water mixing models would be updated annually with the most recent data from the groundwater and surface water monitoring programs to design annual pumping programs that would not have a significant effect on beneficial uses of Mendota Pool water. Assuming that water from the DMC is of comparable quality to that of recent years, the model results would indicate whether the proposed pumping program for each year would meet surface water criteria for irrigation use, protection of aquatic life, and refuge water supply. The pumping program (i.e., specification of wells to be pumped for both transfer and adjacent use during each month and the volumes to be pumped) would be adjusted if the model results indicate exceedance of water quality criteria. The small quantity of MPG water that would flow north out of the Mendota Pool and into the San Joaquin River would be pumped into the Pool by the FWD wells. On average, these wells have slightly lower TDS and boron concentrations than water from the DMC. Therefore, the proposed action would not add to the salt and boron loads in the River below Mendota Dam.

4.4.2 NEW WELL CONSTRUCTION

The well construction alternative does not include pumping of groundwater into the Pool for transfer, so the only effects on surface water quality would be due to adjacent use pumping or limited exchange with local users. A much lower volume of groundwater would be pumped into the Pool for adjacent use (no more than 14,000 acre-feet per year), and the potential effect on surface water quality would be less than under the proposed action. However, this pumping would not be subject to the adaptive management measures or design constraints that would be applied to the proposed action.

4.4.3 LAND FALLOWING

As with the well construction alternative, fallowing of land would eliminate pumping of groundwater into the Pool for transfer, so the only effects on surface water quality would be due to pumping for adjacent use or limited exchange with local users. The potential effects of the land fallowing alternative are the same as for the new well construction alternative.

4.4.4 CUMULATIVE EFFECTS ON SURFACE WATER QUALITY

Water in the Mendota Pool is derived from freshwater runoff, import from the Delta via the DMC, and MPG and other groundwater pumping. Water from the DMC and from MPG wells contributes salts to the Pool. MPG pumping for adjacent use is included in the surface mixing models for salinity (as TDS) and boron, thus, effects of this pumping are taken into account when the annual pumping program is designed. Due to the high turnover of water within the Pool, the MPG inputs are significantly diluted. Reclamation is currently evaluating effects of the sumps and other pump-ins along the DMC on water quality in the canal. Any reduction in the volume of water introduced into the DMC from these sources would improve water quality in the DMC as it enters the Pool, thereby improving overall water quality.

The 2,400 acre-feet of water proposed to be pumped by the City of Mendota into the Fresno Slough would likely increase the salt concentrations in the Slough slightly. Based on a volumetric relationship, this increase would be about 5 percent of the salts introduced by MPG pumping. The MWA generally drains its waterfowl ponds into the Slough in the spring and withdraws water from the Pool to fill its ponds primarily in September and October. The pumping program would be designed each year so that the water quality in the Pool would not exceed the applicable water quality objectives. Therefore, the proposed action in conjunction with pumping for adjacent use is not expected to significantly affect water quality from a salinity perspective.

Results of the TDS mixing model for the MWA shown on Table 4-4 indicate that MPG pumpage for adjacent use would cause an average TDS increase during the pumping months (January-November) of 39 mg/L during Year 2 and 58 mg/L during Year 10. The predicted average annual TDS concentrations in the MWA due to all factors are 448 mg/L during Year 2 and 475 mg/L during Year 10. During the fall months, the predicted cumulative concentrations do not exceed 450 mg/L in any year of the 10-year project.

The boron mixing model results shown on Table 4-5 indicate that MPG pumpage for adjacent use would cause an average increase of 0.02 mg/L (January-November) in the MWA during Year 2 of the proposed action. The average predicted boron concentration for this period due to all factors is 0.23 mg/L.

The TDS and boron mixing models for the San Joaquin River branch of the Pool (Tables 4-6 and 4-7) do not include pumpage for adjacent use in FWD because water pumped for irrigation within FWD is not pumped into the Pool. Therefore, groundwater pumping for adjacent use in FWD would not affect surface water quality in the San Joaquin River branch of the Pool.

The surface water quality monitoring program in the Pool was instituted to ensure that applicable water quality standards are met. Annual pumping programs incorporate design constraints and are subject to adaptive management during the pumping season, so that water quality standards would not be exceeded during the 10-year proposed action. Therefore the cumulative impact of the 10-year proposed action on surface water quality is considered to be less-than-significant.

4.5 SEDIMENT QUALITY

The proposed action, or an alternative, would have a significant impact on sediment quality if it would result in the accumulation of salts and trace elements (arsenic, boron, molybdenum, and selenium) in sediments to concentrations that are toxic to aquatic life.

Because the constituents of interest for the Mendota Pool are naturally occurring, little information is available describing the bioavailability and toxicity of these constituents from sediment to aquatic organisms. Specifically, of the constituents of interest present in the Mendota Pool, the USEPA ARCS document (USEPA 1996) presents information only for arsenic. The USFWS (Reclamation 2000) has provided sediment toxicity guidance only for selenium.

Limited data are available with which to evaluate the potential for project effects on sediment quality in the Mendota Pool. Three lines of evidence are suitable for this analysis: 1) exceedances of sediment quality criteria, 2) the spatial pattern of sediment quality, and 3) concentrations in source water.

4.5.1 PROPOSED ACTION

As discussed in Section 3.5, sediment quality criteria for arsenic and selenium are not exceeded in Pool sediments. Corresponding criteria are not available for boron, molybdenum, or salts (TDS or EC).

Sediment quality data from October 2001 and 2002 indicate that arsenic, boron, and EC are generally highest near the outfall from the DMC. No clear pattern in the concentration of metals is evident in other portions of the Pool.

As discussed in Section 4.4, the MPG production wells are not currently contributing elevated concentrations of arsenic, molybdenum, or selenium to surface waters in the Pool. Therefore, it is unlikely that MPG inputs would increase concentrations of these analytes in the sediments. Boron is present in groundwater at concentrations near the lowest applicable water quality criterion. Modeling conducted for previous pumping programs does not indicate that MPG pumping would result in exceedance of water quality criteria for boron in surface water in the Pool. Salts are added to surface water in the Pool from groundwater. However, as the salts are highly soluble, it is unlikely that they would accumulate in the sediments.

None of the three lines of evidence suggest that MPG pumping has contributed, or would contribute, to accumulation of salts and trace analytes in the sediments. Maintenance of surface water quality would serve to maintain sediment quality. Continuation of the sediment monitoring program throughout the duration of the 10-year pumping program would provide a means to ensure that sediment quality is maintained. Therefore, the proposed project will not have a less-than-significant effect on sediment quality.

4.5.2 New Well Construction

This alternative would have no effect on sediment quality in the Mendota Pool. Since water from the new wells would be applied directly to MPG lands in SLWD and WWD, this alternative would not affect any sediments in these areas.

4.5.3 Land Fallowing

This alternative would have no effect on sediment quality in the Mendota Pool. No additional water would be applied to lands in SLWD or WWD, therefore there would be no effect on sediment quality in these areas.

4.5.4 Cumulative Effects on Sediment Quality

The sediment quality data available from the August and October 2001, and October 2002 surveys do not indicate that MPG pumping is affecting sediment quality in the Pool. Analysis of groundwater quality data from MPG production wells further supports the conclusion that these wells are not contributing arsenic or selenium to surface waters and hence to sediments. Since the MPG wells are not introducing arsenic and selenium to the Pool, the proposed pumping program would not contribute to cumulative impacts due to either of these constituents.

Salts may also be introduced into the Pool via the DMC or the James Bypass. Sediment EC measurements are highest at the DMC, along Lateral 6, and at the James ID booster plant, whereas EC measurements are lowest in the center of the Fresno Slough and at the Columbia Canal on the San Joaquin River arm. This pattern indicates that the MPG wells are not contributing to cumulative impacts on sediment quality in the Pool.

4.6 Biological Resources

The proposed action, or an alternative, would be considered to have a significant effect of biological resources if it would result in modification of existing habitat, degradation of soil quality through accumulation of salts, or accumulation of salts or trace elements (arsenic, boron, molybdenum, or selenium) in surface water, soils, or sediments at concentrations that are toxic to aquatic plants or wildlife.

4.6.1 Proposed Action

The potential effects of the proposed project on biological resources were evaluated relative to habitat modification, irrigation water quality, and aquatic toxicity. No significant impacts to biological resources have been identified in previous environmental documents associated with this project (Jones and Stokes 1995; Jones and Stokes and LSCE 1998; Reclamation 2001; Reclamation 2002), or in the monitoring program (LSCE and KDSA 2001; LSCE and KDSA 2002).

4.6.1.1 Habitat modification

Land subsidence due to drawdowns caused by MPG pumping is unlikely to alter habitat conditions in the vicinity of the Pool by changing patterns of flooding. Land subsidence due to MPG transfer pumping is limited to 0.05 foot over the 10-year period at the Yearout Ranch and Fordel extensometers. This is in addition to subsidence caused by all other pumping activities. This amount of subsidence is unlikely to alter surface water flow patterns in the project vicinity. Furthermore, habitat outside of the Pool is limited due to the intensive agricultural land use.

The proposed action would not decrease the acreage of idle land (defined as land that has once been in agricultural production but has not had agricultural manipulation for two or more years) throughout the duration of the project. Currently, there are no idle MPG agricultural lands (M. Carpenter, 2002, pers. comm.). The pumping project may decrease the amount of fallowed land (agricultural land that has been disced, irrigated, mowed or otherwise manipulated to control weeds) over the no action alternatives. Practices used to maintain fallowed land generally reduce the growth of vegetation, which reduces the amount of potential cover from predators and severely limits the habitat value of fallowed land for species such as the San Joaquin antelope squirrel, giant kangaroo rat, and burrowing owl. Therefore, biological impacts to terrestrial species on fallowed lands are not expected to occur.

4.6.1.2 Irrigation water quality

The suitability of soils for agricultural uses may be affected by the accumulation of salts. The sodium adsorption ratio (SAR) is an indication of the potential for irrigation water to increase salt loading in the soils to which it is applied. The evaluation of the SAR in conjunction with measured salinity (Section 3.3.2) indicates that surface waters in the Pool are currently slightly to moderately impaired for irrigation use. The design constraints of the proposed action would maintain the salinity in the Pool at the current levels, but would increase salinity in the Pool above that in the DMC. However, the water quality would continue to be acceptable for agricultural uses. This is not considered to be a significant effect.

4.6.1.3 Aquatic Toxicity

Water quality criteria for refuge water supply and for aquatic life protection are presented in Table 3-4. Target values represent concentrations below which no adverse effects are likely. Severe or unacceptable values are concentrations at which adverse or toxic effects may become evident. Refuge water supply objectives (CDFG 2001) and aquatic life protection criteria (Sacramento River and San Joaquin River Basin Plan) are used to assess potential impacts to wildlife species, including the giant garter snake, amphibians, fish, and other special-status species. Aquatic and riparian species, such as amphibians and the giant garter snake, may be more susceptible to degradation of surface water quality than upland species that utilize surrounding agricultural lands.

USFWS has developed risk-based screening criteria for selenium (cited in Reclamation 2000 and shown in Table 3-4) that are considered to be protective of both aquatic and terrestrial plants and wildlife resources in the Grasslands Watershed and Kesterson Wildlife Refuge. These criteria represent protective levels for long-term (chronic) exposure resulting in effects to wildlife reproduction due to bioaccumulation. The risk-based target for selenium in surface water is 2 μg/L as a monthly average. This value is protective of plant and wildlife resources in the MWA, including special-status species. The USFWS guideline has been adopted by the CVRWQCB as the criterion for selenium in surface waters. Adverse effects due to bioaccumulation and food chain transfer may occur from chronic exposure to aquatic selenium concentrations of 5 μg/L or greater.

It is unlikely that plants and wildlife in the Pool or the MWA, including special-status species, would be exposed to concentrations resulting in significant bioaccumulation of selenium or toxicity of arsenic, molybdenum, or boron in surface water as a result of the proposed action. Selenium and arsenic concentrations have been consistently below detection limits in groundwater samples (Section 3.4.5). Molybdenum in groundwater has been below applicable water quality criteria. Although boron in groundwater exceeds the CDFG criterion for refuge water supplies, no exceedances of the "unacceptable" level have been consistently detected in surface waters of the Pool.

Future sampling of groundwater and surface water would be conducted to monitor arsenic, boron, molybdenum, and selenium concentrations. Modifications to the pumping program will be made as necessary to avoid exceedances of water quality criteria. The potential for toxic effects from trace elements to aquatic life is considered to be less-than-significant.

The USFWS and EPA have not established water quality criteria for TDS to ensure the protection of birds and other terrestrial wildlife, and the California State Water Resources Control Board (SWRCB) has not established standards for the San Joaquin River near the project site. TDS objectives for the Mendota Pool/Fresno Slough water delivery system to the MWA include: the 5-year average shall not exceed 400 mg/L, the annual mean shall not exceed 450 mg/L, the monthly mean shall not exceed 600 mg/L, and the daily mean shall not exceed 800 mg/L (Reclamation Water Contract Number 14-OC-200-7859A for Refuge Water Supplies to Mendota WA).

Direct toxicity due to increased salinity (as EC or TDS) is unlikely to occur to aquatic wildlife species. Using data on the physiological responses of fish, plants, and terrestrial wildlife to salinity, Jones and Stokes (1995) did not identify any potential significant impacts to fish, plants, or wildlife, including special-status species, due to elevated TDS concentrations in the Pool as a result of the program described in the 1998 FEIR.

The design constraints incorporated into the pumping program are intended to minimize impacts to surface water quality in the Pool. Pumping from wells with TDS concentrations greater than 2,000 mg/L has been discontinued. During the fall, when the largest volumes of water are delivered to the MWA, wells with TDS higher than 1,200 mg/L would not be pumped. The pumping program would increase TDS concentrations, particularly from some wells in the southern portion of the Pool. Mitigation measures have been incorporated into the program to minimize this impact. The analyses performed to assess these impacts indicate that there is sufficient dilution to ensure that the increase in TDS would be small and applicable water quality standards would be met. Additional measures to reduce the input of salt loads would be taken during the fall months to reduce the potential impact to the MWA. Therefore, impacts related to changes in TDS concentrations on biological resources in the Pool and the MWA, including special-status species like the giant garter snake, are considered to be less-than-significant.

A sediment monitoring program was implemented during the 2001 pumping season to provide a baseline characterization of metal concentrations in Pool sediments and to allow future tracking of temporal and spatial trends in sediment quality. Results of the monitoring program are discussed in Section 3.5. There are no indications that the proposed action would result in sediment quality criteria for selenium or arsenic being exceeded during the 10-year program. Analysis of the recent sediment data (October 30, 2001), with improved detection limits and data quality, indicated that selenium concentrations did not exceed the 2 mg/kg (dry weight) criterion, with detection limits ranging from 0.9 to 1.2 mg/kg (dry weight). Selenium was detected only once (0.4 µg/L) in groundwater samples collected from MPG production wells in 2001. This indicates that the MPG wells are not introducing selenium into the Pool and hence to Pool sediments. Selenium inputs to the Pool from groundwater have been shown to be negligible and would not result in accumulation of selenium in Pool sediments.

The data for arsenic show a maximum concentration of 10.9 mg/kg (dry weight) (October 30, 2001) at the mouth of the DMC. The concentrations in the sediment samples did not exceed the 12.1 mg/kg (dry weight) USEPA (1996) sediment quality guideline. These data indicate that the MPG wells do not influence arsenic concentrations in the sediments.

The impacts of the pumping program would have less-than-significant effects on sediment quality, based on the monitoring data, which indicate that sediment levels of arsenic, selenium or TDS are not increased by the pumping program. Sediment quality impacts on aquatic life are less-than-significant.

4.6.1.4 Special Status Species

Special-status species in the Pool, MWA, and in nearby agricultural lands are listed in Table 3-12 (see Section 3.7 Biological Resources). The USFWS has identified the giant garter snake, an aquatic snake that utilizes wetland areas during its active season, but moves to upland areas for cover and refuge from floodwaters during its dormant season in the winter as being potentially susceptible to changes in water quality in the Pool (Winkle, pers. comm. 2001). CDFG refuge managers have identified the following special-status species at MWA including giant garter snake, white-faced ibis, Swainson’s hawks, and tricolored blackbirds. Fresno kangaroo rats have been recorded at the adjacent Alkali Sink Ecological Reserve. Special-status plants species include palmate-bracted bird’s beak, heartscale, and Hoover’s eriastrum. Sanford’s arrowhead is a special-status plant that has been recorded near the Mendota Pool.

As discussed above, it is unlikely that special-status plants and wildlife in the Pool or the Mendota Wildlife Area would be exposed to concentrations resulting in significant bioaccumulation of selenium or toxicity of arsenic, molybdenum, or boron in surface water as a result of the proposed action. Future sampling of groundwater and surface water would be conducted to monitor trace element concentrations.

The pumping program would increase TDS concentrations, particularly from some wells in the southern portion of the Pool. However, mitigation measures have been taken to minimize this increase. Additional measures to reduce the input of salt loads would be taken during the fall months to reduce the potential impact to the MWA. The analyses performed to assess these impacts indicate that there is sufficient dilution to ensure that the increases would be small and applicable water quality criteria would continue to be met. Therefore, impacts related to changes in TDS concentrations on special-status biological resources in the Pool and the MWA from the mitigated program are considered to be less-than-significant.

The pumping program not effect sediment quality in the Pool, based on historical monitoring data which indicate that sediment levels of arsenic, selenium, or TDS are not increased by the pumping program. Therefore, biological resources will to be effected by changes in sediment quality.

4.6.2 NEW WELL CONSTRUCTION

This alternative would have no effect on plant or wildlife resources in the vicinity of the Mendota Pool as all water supplies would be produced elsewhere in SLWD and WWD. This alternative would have no effect on plant or wildlife species in SLWD or WWD, as there would be no change to current land use practices. There would be no increased fallowing of lands, nor would the amount of land currently in production be increased.

4.6.3 LAND FALLOWING

The project could affect wildlife species that may be present on SLWD or WWD lands if lands become idled. If land is idled (i.e., left without any manipulation) rather than fallowed, wildlife species could recolonize the idled lands. Subsequent reconversion to agriculture would involve plowing or disking and application of weed control chemicals. These activities could adversely affect wildlife species in the recolonized lands. However, if the land is subjected to routine weed control and disking, it is unlikely that the land would be recolonized and no impacts would occur to wildlife species when the land is brought back into production.

This alternative assumes that the agricultural lands are only temporarily (1 to 2 years) taken out of production, and that lands would be fallowed as part of a routine crop rotation. Therefore, the effects of this alternative on plant and wildlife species is less-than-significant.

4.6.4 CUMULATIVE EFFECTS ON BIOLOGICAL RESOURCES

Conditions that result in poorer water quality may increase the potential for adverse impacts on wetland plants and animals. The surface water and groundwater quality monitoring program provides a mechanism to predict and evaluate surface water quality impacts. These potential impacts are most likely to be seen in the MWA because these areas provide the most valuable habitat for listed species, but may also occur in other areas of the Pool.

Water in the Mendota Pool is derived from freshwater runoff, transport from the Delta via the DMC, and MPG and other pumping. Water from the DMC and MPG wells contributes salts to the Pool. Calculated and measured TDS levels in Mendota Pool surface water are generally well below the concentrations expected to adversely affect plant or wildlife resources (Table 3-4). TDS concentrations in the Pool are likely to increase with implementation of the proposed action, particularly in the southern portion of the Pool, but are likely to be below TDS objectives set for the water delivery system to the MWA.

Selenium concentrations in the Pool are below the water quality criterion determined by USFWS (Reclamation 2000) to be protective of plant and wildlife resources, and the proposed action might actually decrease selenium levels slightly within the Pool.

The sediment quality data available from the monitoring program do not indicate that MPG pumping is influencing sediment quality in the Pool. Analysis of groundwater quality data from MPG production wells (Tables 3-7 and 3-8) further supports the conclusion that these wells do not contribute arsenic or selenium to surface water, and hence to sediments. Therefore, cumulative impacts to sediment concentrations of selenium and arsenic would not occur due to the pumping program.

Salts may also be introduced to the Pool via the DMC or the James Bypass. Sediment EC measurements are highest near the Mendota Dam and along Lateral 6, but lowest in the center of the Fresno Slough and at the Columbia Canal on the San Joaquin River arm (Table 3-9). This indicates that MPG wells are not contributing to cumulative impacts on sediment quality in the Pool (See Section 4.5.4 Cumulative Effects on Sediment Quality).

The cumulative effects of the pumping program on biological resources, including special-status species like the giant garter snake, in the Pool or MWA are considered to be less-than-significant because:

- Selenium and other constituents (arsenic, boron, and molybdenum) in surface water and in pumping wells do not exceed target values set by the USEPA and the USFWS.
- Increases in TDS concentrations in the Pool are minimized through application of design criteria and will maintain concentrations below target levels.
- Introduction of groundwater from MPG production wells to the Pool does not reduce sediment quality.
- Potentially toxic concentrations of salts and trace elements will not be present in surface waters or sediments.

4.7 COST OF EXCHANGED WATER

A project objective is to obtain water at less than the cost of water on the open market. During 2000 and 2001, this was approximately \$125 to \$130 per acre-foot. The following analysis identifies the projected costs of implementing the proposed action and each of the alternatives. Costs are expressed relative to an acre-foot of water exchanged.

The basic assumptions relating to the implementation of each alternative are discussed in Section 2.1. Costing assumptions specific to each alternative are discussed within the discussion of the alternative. All costs are based on 2002 rates and fees and are average expected costs. The rates and fees used in these cost estimations are expected to vary over time. Certain simplifying assumptions were also made in estimating quantities of materials (e.g., piping) needed for each alternative. Therefore, the costs presented in this section should be considered estimated values, and should be used for comparative purposes only. Table 4-8 summarizes the costs of the water exchanged for each of the alternatives considered. The cost calculations are provided in Appendix E.

There are four main components of the costs: (1) permitting costs, (2) Reclamation and water district fees, (3) water extraction costs, and (4) monitoring and reporting costs. All costs are expressed as the cost per acre-foot of water to be exchanged with Reclamation.

4.7.1 PROPOSED ACTION

Permitting costs include the preparation of the environmental documents, analysis of previous monitoring data, and the costs of negotiations with other interested parties including SJREC, NLF, Spreckels Sugar, Inc. Reclamation, U.S. Fish and Wildlife Service, California Department of Fish and Game, and the Regional Water Quality Control Board. Preparation of the required environmental documentation and permits is estimated to cost $1.75 per acre-foot exchanged. Other additional expenses incurred as part of this project are estimated at $1.20 per acre-foot exchanged and would include legal and other ongoing costs.

Reclamation imposes a fee per acre-foot of water exchanged to cover administrative costs and the costs of the use of Reclamation facilities to transfer the exchanged water. These charges are determined annually and are based on Reclamation's annual water marketing charge. Reclamation imposed a charge of $5.77 per acre-foot of water exchanged as part of the 2002 Exchange Agreements with the MPG members. This charge was $6.91 in 2001. An average value of $6.50 was assumed in this cost analysis.

The San Luis and Delta-Mendota Water Authority (SLDMWA) acts to coordinate water deliveries for the various water districts surrounding the Pool. The SLDMWA charges a variable fee per acre-foot of water exchanged with Reclamation based on annual water supply. In 2001 this fee was $16.51 per acre-foot, whereas in 2002 the fee was $9.12. A long-term average value of $15.00 was assumed in this cost analysis. This fee covers a variety of charges including conveyance operations and maintenance, administrative fees, and the costs of the power needed to pump water at the O'Neill and Dos Amigos pumping plants. This fee also covers the cost of delivering water from the O'Neill Forebay to the WWD or SLWD turnouts on the San Luis Canal. Similarly, fees charged by Westlands Water District for the use of their facilities to deliver water to the irrigated lands are based on water supply. In 2001, WWD operation and maintenance fees totaled $13.31 per acre-foot; in 2002 these fees were $11.79. An average rate of $12.00 per acre-foot was used in this cost estimate.

Water extraction costs vary based on the depth of the well, and the energy source used to power the pumps. For MPG wells perforated in the deep zone (i.e., below 130 feet), the average cost to pump one acre-foot of water is $47. For MPG wells in the shallow zone, the average cost is $33 per acre-foot (M. Carpenter, pers. comm.). The proposed action would pump up to 12,000 acre-feet of water from the deep zone and up to 19,600 acre-feet from the shallow zone in a normal year (Table 2-2). Average pumping costs would be $38.63 per acre-foot for each of the 25,000 acre-feet to be exchanged with Reclamation under the proposed action. This cost is also applicable to the water pumped into the Pool for exchange with other users.

Monitoring and reporting requirements are included in the proposed action. Monitoring program costs were estimated from the costs incurred in previous years and include sample collection, laboratory analyses, and cost of equipment. Reporting costs would include analysis of the monitoring data and preparation of the annual summary report. The estimated annual cost for the monitoring program is $10.50 per acre-foot exchanged.

The costs of water for the proposed action would include the permitting costs, Reclamation and water district fees, water extraction costs, and monitoring and reporting costs as described above. The proposed action would deliver water to MPG members at an average cost of $99 per acre-foot (Table 4-8).

4.7.2 New Well Construction

Costs for the New Well Construction alternative are derived from the costs of the installing new wells and associated infrastructure to supply 25,000 acre-feet of water per year to the MPG farmland in WWD and SLWD.

The cost of installing a new well in WWD or SLWD is approximately $250,000 per deep well (M. Carpenter, pers. comm.). It is assumed that this amount would be financed through a 15-year loan at 6% interest. A 15-year loan is assumed due to the short lifespan of groundwater wells along the western side of the San Joaquin Valley. A minimum of 55 wells would be required if the wells were to pump at full capacity throughout the entire summer irrigation season. Up to 125 wells could be required to meet peak demands. Since other water would be concurrently delivered, it was estimated that 75 wells would be needed.

The infrastructure costs associated with this alternative include the cost of piping ($40 per foot) to deliver the water to adjacent fields. It was assumed that 1/4 mile of piping would be required in the upgradient direction and 1/2 mile of piping in the downgradient direction. A portion of the water produced by the wells would have to be boosted for delivery to upgradient areas. Costs were calculated assuming a boosting rate of $14 per acre-foot, and that 1/3 of the water would require boosting to deliver it to the irrigated fields.

Water extraction costs for wells completed below the Corcoran Clay in WWD and SLWD are generally higher than for wells adjacent to the Pool due to their depth. Water extraction costs in WWD are estimated to be $50 per acre-foot (M. Carpenter, pers. comm.) based on 2000 energy rates. Future costs may be higher due to need to purchase energy on the spot market.

Some water (up to 9,000 acre-feet per year) would continue to be pumped into the Pool for exchange with other users around the Pool. The average cost of pumping that water would be $38.63 per acre-foot (i.e., the same cost as in the proposed action).

No monitoring would be conducted if this alternative is implemented. Reclamation and SLDMWA fees would not be applicable. However, WWD fees for the use of WWD facilities to transport water would be applicable.

The estimated cost for the new well construction alternative is $289 per acre-foot of water exchanged (Table 4-8).

4.7.3 LAND FALLOWING

The analysis presented for this alternative contains two cost components. First, there is the cost (as lost income) to the farmer due to the inability to produce crops on the fallowed land. Second, there is the cost to individual farmworkers due to the loss of income from labor that is no longer required. This analysis does not evaluate the loss to the economy of the surrounding community resulting from the loss of the farmworkers' expenditures. This analysis does not address the losses to the local economy due to the lack of purchases of goods and services by the farmers who chose to fallow land.

The water requirement for an acre of active cropland in WWD is approximately 3 acre-feet per acre per year (M. Carpenter, pers. comm.). Approximately 0.5 acre-foot per acre per year is required for weed control on fallowed land. Therefore, it was assumed that 2.5 acre-feet of water would be saved for each acre of land fallowed. Approximately 10,000 acres of land would be fallowed each year to save the equivalent of 25,000 acre-feet of water.

The average value of crops produced per irrigated acre was calculated as the average value for each crop ($/acre) weighted by the number of acres of each crop grown in WWD. The number of acres of each crop was obtained from the WWD Water Management Plan (WWD 1999). The crop values were obtained from the Fresno County crop report (Fresno County 2000). The analysis assumes that permanent crops (such as trees or vines) would not be fallowed and that there would be no seasonal crop rotation (only one crop per field per year). Permanent crops are not considered in deriving the average crop value per acre. The average crop value per acre is estimated to be about $2,000.

The labor cost is based on the average labor required over the course of a year. Estimates were obtained from the number of employees and number of acres farmed by each MPG member (M. Carpenter, pers. comm.). On average one employee is required for every 80 to 90 acres farmed. Therefore, if 10,000 acres were fallowed, approximately 111 to 125 fewer employees would be required. The per employee salary is estimated based on the California minimum wage and assumes year-round full-time employment.

If the proposed action is not implemented, no monitoring would be conducted. Reclamation, SLDMWA, and WWD operations and maintenance fees that are based on the amount of water used would not be applicable. Land based charges would still be applicable, but would be the same for all alternatives and therefore are not considered.

The estimated cost is approximately $801 in crop losses per acre-foot equivalent, and $62 in lost income to farm laborers per acre-foot equivalent (Table 4-8).

4.8 CENTRAL VALLEY PROJECT OPERATIONS

The proposed exchange would be authorized under the federal Warren Act which specifies that any entity wishing to use Reclamation facilities to transfer water may do so, subject to certain conditions. These conditions include the provision that there is sufficient excess capacity available in the system to effect the transfer, and that the entity provides the necessary power required to move the water. The proposed action, or an alternative, would have a significant impact on CVP operations if it would result in exceedance of the capacity of the Federal portions of the San Luis Reservoir or San Luis Canal to store or convey water to existing users.

Proposed Action

The proposed action would exchange up to a maximum of 25,000 acre-feet of water per year during each of the six normal years and the two dry years. Water would be pumped into the Pool by the MPG between April and November of each year. In exchange the MPG would receive water on their lands in SLWD and WWD via the SLC. The proposed project would result in the redirection of water present in the Clifton Court Forebay from delivery via the DMC to delivery via the SLC.

4.8.1.1 Flow in San Luis Canal

Available Federal capacity in the SLC is approximately 4,000 cfs (7,932 acre-feet per day) during peak discharge (see Section 3.3.1.2). The maximum rate of MPG pumping is 95 to 100 cfs. The MPG pumping program would not significantly affect available capacity of the SLC.

4.8.1.2 Storage in San Luis Reservoir

Under past agreements between Reclamation and the MPG, exchanged water has been made available to the MPG within two weeks of the close of the month in which it was pumped. Under a typical program (Table 2-2), the MPG would have pumped 25,000 acre-feet into the Pool by mid-October. Since it is likely that the Pool Group would take water from the SLC once Reclamation authorizes the exchange, all water could be exchanged by the middle of November. The MPG would still need to obtain water at this time for their permanent crops. Given this scenario, no water would be stored in the SLR over the winter months.

Should the MPG delay exchange of water until the latter part of the season, the last month's pumpage (2,900 acre-feet) may have to be stored in the SLR. The available Federal capacity in the SLR is estimated to be at least 4,150 acre-feet (see Section 3.3.1.1). Storage of MPG water for release during the following growing season would not cause the Federal storage to exceed its available capacity.

4.8.1.3 Power

Effects on power requirements would be equivalent to the difference between the power requirement to pump 25,000 acre-feet of water via the DMC and the power requirements to pump that same water via the SLC. Additional power requirements may occur if water is temporarily stored in San Luis Reservoir.

The San Luis and Delta-Mendota Water Authority (SLDMWA) acts to coordinate water deliveries for the various water districts surrounding the Pool. The SLDMWA charged a fee of $16.51 per acre-foot of water exchanged with Reclamation in 2001. This fee covered a variety of charges including conveyance operations and maintenance, administrative fees, and the costs of the power need to pump water from the O'Neill Forebay (Check 13) to the San Luis Reservoir from the O'Neill and Dos Amigos pumping plants. This fee is charged to the MPG for all water exchanged.

4.8.1.4 Summary

The MPG pumping program would not result in exceedance of either the available capacity in the SLC or the storage in the SLR. The MPG would not affect the availability of project or preference power to other users. Therefore, the proposed action would not have a significant effect on Central Valley Project operations.

4.8.2 New Well Construction

This alternative would have no effect on CVP operations. No additional water would be transferred to MPG properties located in SLWD or WWD.

4.8.3 Land Fallowing

This alternative would have no effect on CVP operations. No additional water would be transferred to MPG properties located in SLWD or WWD.

4.9 Archeological and Cultural Resources

Cultural resources is a broad term that includes prehistoric, historic, architectural, and traditional cultural properties. Land use in the project vicinity is currently agricultural. The proposed action and all alternatives seek to maintain current land uses. The proposed action and all alternatives do not include a change in any existing land uses or construction of new facilities. There are no effects on archaeological or cultural resources for the action and any alternative.

4.10 Indian Trust Assets

Indian Trust Assets are legal interests in property or rights held in trust by the United States for Indian Tribes or individual Native Americans. Trust status originated from rights imparted by treaties, statues, or executive orders. Such assets cannot be sold, leased, or otherwise alienated without federal approval. The distribution of Indian reservations, rancherias, and public domain allotments throughout the project area was reviewed. No Indian lands of any type were found within the study area. There are no significant effects.

4.11 ENVIRONMENTAL JUSTICE EVALUATION

Executive Order 12898 of February 11, 1994 requires federal agencies to ensure that their actions do not disproportionately impact minority and disadvantaged populations. The market for seasonal workers on local farms draws thousands of migrant workers, commonly of Hispanic origin. The population of some small communities typically increases during late summer harvest.

Without the exchanged water, some field crops may not be planted or may become stressed, which could lower production. The proposed action and the New Well Construction alternative would help maintain agricultural production and local employment, and would therefore result in a net benefit to the local population. The Land Fallowing alternative may result in reduction of the work force due to removal of lands from agricultural production.

4.12 SOCIOECONOMIC RESOURCES

Agriculture is a very important industry in Fresno and Madera counties. Agriculture takes on additional significance because it is generally considered a “primary” industry (along with mining and manufacturing). A reasonably large portion of activity in non-primary industries can be attributed to support for primary industry activity in an area. Changes in primary industry activity, therefore, usually precipitate additional changes in non-primary, or support, industries.

The Hispanic community makes up a large portion of the regional population. The land fallowing alternative may result in an insignificant drop in employment if there is a reduction in agricultural production. The proposed action would help maintain current levels of employment.

4.13 LAND USE

The proposed action does not propose any change to, or conflict with, current land use designations or zoning and would have no effect on land use.

The No Action Alternatives do not propose any change or conflict to current land use designations or zoning and would have no effect on land use.

4.14 TRANSPORTATION

The proposed action does not propose any change to local or regional circulation and would have no effect on the transportation in the project area.

The No Action Alternatives would not change local or regional circulation and would have no effect on the transportation in the project area.

4.15 AIR QUALITY

4.15.1 PROPOSED ACTION

Potential emission sources from the implementation of the pumping agreement under the proposed action include dust (particulate) sources associated with the use of heavy farm equipment and particulate and oxides of nitrogen from non-electric groundwater pump operation emissions. While the application of pesticides and fertilizers would not be considered an emission source, and therefore would not affect air quality, levels of exposure to these potentially toxic materials are determined by the amount of a pesticide or fertilizer residue in ambient air. Rates of exposure are determined for inhalation, ingestion or dermal absorption, depending on the chemical. Under the proposed action, no additional wells would be proposed. Pumping would be limited to the use of existing well pumps only. If existing well pumps are electric and farming operations are consistent with previous seasons, the proposed action would have no effects on air quality.

Under the proposed action potential increases in particulate emissions could result from the operation of heavy farming equipment if farming operations are inconsistent with previous seasons. Potential increases in particulate and oxides of nitrogen emissions could result from the operation of non-electric groundwater pumps. Assuming there is no change in farming operations and that existing pumps are electric, the Proposed action would have no effect on air quality.

4.15.2 NEW WELL CONSTRUCTION

Under this alternative, new groundwater pumping wells would be needed to make up for lower water deliveries. An estimate of 75 to 125 new groundwater pumping wells with electric engines would be constructed. Pumps may be fitted with additional “boosting” equipment for adequate pressure to bring groundwater to field level.

New wells would be constructed to provide irrigation water for overlying lands that would use equipment subject to registration and/or permitting as portable engines under California Air Resources Board’s (CARB) “Portable Engine Registration Program.”

The duration of air quality effects from permitted/registered construction equipment is not anticipated to have any significant or prolonged effect on air quality.

Agricultural irrigation pumps used for farming operations are currently not subject to state regulations enforced under the CARB. The new groundwater pumps with electric engines, and any ancillary electric “boosting” equipment, would pose no effect on air quality.

Under the New Well Construction alternative, an estimated 75 to 125 new wells, fitted with an electric pump, would be constructed. Continued water supply deliveries would support existing and future agricultural land uses, which currently contribute to air pollutant emissions. The pollutant emission volumes and rates from these land uses is not expected to vary between the New Well Construction alternative and the proposed action.

In the New Well Construction alternative, agricultural land uses in the Mendota area would include similar crops and cropping patterns. These cultivation measures are similar to methods used on lands historically used for agricultural operations. It is anticipated that air quality under the New Well Construction would be similar to present conditions described in the Affected Environment.

4.15.3 Land Fallowing

Preparing agricultural areas for fallowing may require the use of heavy farm equipment which is associated with dust (particulate) emissions. However, this use is limited and it is not anticipated to have any significant or prolonged effect on air quality.

4.16 Noise

Under the New Well Construction alternative, groundwater pumping by the MPG would increase to make-up for water needs not delivered by CVP. Their proposed locations would remain within agricultural areas and not in proximity to sensitive receptors. Therefore, there would be no effect on noise.

4.17 Summary of Effects

Table 4-9 compares the potential environmental effects of the proposed action and the two no action alternatives. Each of the resource areas is addressed for each alternative. The primary effects shown on Table 4-9 are summarized below:

- The proposed action could have effects on local short-term drawdown resulting in increased pumping costs to nearby users. The MPG has agreed to mitigate this effect by compensating the other groundwater pumpers for the additional cost of extracting the groundwater.

- The New Well Construction alternative would have a significant adverse effects on short-term groundwater levels, long-term overdraft, and land subsidence. The land subsidence in WWD could adversely affect the San Luis Canal resulting in loss of freeboard or potential infrastructure damage.

- The proposed action would have a significant adverse effect on groundwater quality due to increased rate of groundwater degradation west of the Fresno Slough. In the shallow zone, only MPG wells would be affected. In the deep zone, the effect would primarily be to MPG wells, but slight impacts would also be expected in several non-MPG wells in the area.

- The proposed action would increase the salt concentration of the Fresno Slough branch of the Mendota Pool thereby increasing the salt load to irrigated lands in the southern portion of the Pool. Each annual pumping program will be designed to ensure that water quality criterion for salts is met.

- The proposed project will not effect the existing TMDL's for salt and boron in the San Joaquin River.

- The proposed project will not contribute to exceedances of water quality criteria for selenium in the Pool or increase loads to the Pool.

- Should the MPG require water to be stored in the San Luis Reservoir during the late winter due to the proposed action, the additional storage requirement would reduce the available storage, but not eliminate it.

- The cost of water under the New Well Construction alternative is approximately double that of the proposed action and well above the target range of costs.

- The Land Fallowing alternative is expected to result in significant adverse effects on farm income, and on farmworker employment and income due to land being taken out of production. The cost of water under this alternative is approximately eight times that of the proposed action.

- Due to the adaptive management approach taken to maintain surface water quality in the Pool, the proposed action would not adversely impact the water quality at the MWA or effect biological resources that use the Pool. No adverse effects to protected species, specifically the giant garter snake, were identified for any of the alternatives considered in this analysis.

Table 4-1. Simulated MPG Pumpage During 10-Year Proposed Project

Year	Classification[1]	Adjacent Pumpage (acre-feet)	Transfer Pumpage Shallow (acre-feet)	Transfer Pumpage Deep (acre-feet)	Transfer Pumpage Total (acre-feet)
1	Wet	14,000	0	0	0
2	Normal	14,000	19,128	12,000	31,128
3	Normal	14,000	18,620	12,000	30,620
4	Normal	14,000	17,954	12,000	29,954
5	Normal	14,000	17,601	12,000	29,601
6	Wet	14,000	0	0	0
7	Normal	14,000	17,423	12,000	29,423
8	Normal	14,000	16,725	12,000	28,725
9	Normal	14,000	16,725	12,000	28,725
10	Normal	14,000	16,514	12,000	28,514
	Total	140,000	140,691	96,000	236,691
	Mean[2]		17,586		29,586

1. Normal year classification include dry years.
2. Excludes wet years.

Table 4-2. Predicted TDS Change in Shallow Production Wells During 10-Year Proposed Project

			Annual TDS Change[3]				TDS Increase After 10 Years			
Well Owner	**Well ID[1]**	**Initial TDS[2] (mg/L)**	**Regional Gradient (mg/L)**	**Non-Transfer Pumpage (mg/L)**	**MPG Transfer Pumpage (mg/L)**	**Total (mg/L)**	**MPG Transfer Pumpage (mg/L)**	**Total (mg/L)**	**Final TDS (mg/L)**	**Impact of MPG Transfer Pumpage (%)**
Northern Fresno Slough										
Fordel, Inc.	**M-2**	684	-2	1	32	31	319	312	996	100
	M-3	782	-2	1	29	28	290	280	1,062	100
	M-4	769	-1	1	29	29	294	291	1,060	100
	M-5	501	2	1	20	23	201	232	733	87
	M-6	420	6	1	18	25	182	249	669	73
Terra Linda Farms	TL-4A	582	2	1	19	23	191	226	807	85
	TL-4C	737	-1	1	28	29	280	286	1,023	98
	TL-10A	578	3	1	16	20	162	202	780	80
	TL-10B	595	2	1	16	19	157	190	784	83
	TL-10C	493	6	2	14	22	139	222	716	62
	TL-11	468	8	2	13	22	128	224	691	57
	TL-16	592	2	1	18	22	182	216	808	84
	TL-17	568	3	1	21	25	207	249	816	83
Central Fresno Slough										
Terra Linda Farms	TL-13	508	6	6	15	26	151	264	771	57
	TL-14	636	0	5	14	19	136	186	822	73
	TL-15	561	3	4	13	20	130	202	763	64
	TL-12	537	-20	11	20	11	198	106	642	100
Silver Creek Packing Co.	SC-3B	785	-15	11	35	31	355	312	1,098	100
	SC-4B	767	-13	10	34	31	343	307	1,074	100
Coelho/Gardner/ Hanson	CGH-1	1,014	-30	25	29	25	290	249	1,263	100
	CGH-2	1,437	-25	27	34	36	336	357	1,793	94
	CGH-6	1,296	-33	21	28	16	282	159	1,455	100
	CGH-9	1,222	-24	25	32	33	316	329	1,551	96
	CGH-10	943	-23	22	29	28	294	283	1,226	100
Meyers Farming	MS-7	1,860	-25	13	31	19	312	192	2,051	100
Southern Fresno Slough										
Five Star	FS-1	638	-11	2	24	15	245	153	791	100
	FS-2	792	-8	2	30	24	298	239	1,031	100
	FS-3	1,187	-9	3	36	30	357	303	1,491	100
	FS-4	1,121	-5	3	34	31	335	314	1,435	100
	FS-5	639	-11	2	25	17	253	166	805	100
	FS-6	1,450	-20	3	39	23	394	230	1,679	100
	FS-7	1,665	-20	4	43	26	426	262	1,926	100
	FS-8	1,379	-15	3	40	28	398	283	1,662	100
	FS-9	1,340	-16	3	36	23	364	235	1,575	100
	FS-10	922	-2	3	28	29	280	293	1,215	96
Coelho West	CW-1	698	-13	2	23	12	231	120	818	100
	CW-2	705	-13	2	23	11	226	109	814	100
	CW-3	990	-9	1	32	25	324	246	1,236	100
	CW-4	971	-9	1	34	26	341	264	1,235	100
	CW-5	1,316	-7	1	33	27	327	270	1,586	100

1. Wells considered to be impacted by wastewater in addition to the saline front are shown in bold.
   The CGH-1 cluster contains 3 wells. The CGH-6 cluster contains four wells, of which only CGH-6C and 6D were modeled.
2. The initial concentration at each well is based on model results at the end of the 1999-2002 calibration period.
3. Negative values indicate water quality improvements; a total annual degradation rate equal or smaller than the degradation rate due to MPG-transfer pumpage indicates that simulated water quality degradation is due to transfer pumpage, only.

Table 4-3. Predicted TDS Change in Deep Production Wells During 10-Year Proposed Project

Well Owner	Well ID	MPG Well	Initial TDS[1] (mg/L)	Annual TDS Change: Regional Gradient (mg/L)	Annual TDS Change: Non-Transfer Pumpage (mg/L)	Annual TDS Change: MPG Transfer Pumpage (mg/L)	Annual TDS Change: Total (mg/L)	TDS Increase After 10 Years: MPG Transfer Pumpage (mg/L)	TDS Increase After 10 Years: Total (mg/L)	Final TDS (mg/L)	Impact of MPG Transfer Pumpage (%)
North of Mendota											
Central Calif. Irrigation Dist.	CCID 5A	no	521	13	16	1	30	10	301	821	3
	CCID 32B	no	1,681	25	39	1	66	12	655	2,336	2
City of Mendota	City No.3	no	1,799	20	35	3	58	33	580	2,378	6
	City No.4	no	1,824	19	39	3	61	32	611	2,435	5
	City No.5	no	1,438	7	41	3	51	32	509	1,947	6
Northern Fresno Slough											
Fordel, Inc.	M-1	yes	772	3	18	4	26	44	259	1,031	17
Terra Linda Farms	TL-1	yes	752	17	19	4	39	37	395	1,147	9
	TL-2	yes	1,009	11	18	3	32	34	325	1,333	11
	TL-3	yes	530	2	25	8	35	80	346	875	23
	TL-7	yes	794	13	25	3	40	25	403	1,197	6
	TL-8	yes	803	12	24	2	38	24	381	1,184	6
	TL-9	yes	996	19	15	3	37	26	368	1,364	7
Conejo West	ConejoWest	yes	1,090	18	17	3	38	26	375	1,465	7
Coelho/Coelho/ Fordel	CCF-1	yes	1,097	18	15	3	36	26	358	1,455	7
Central Fresno Slough											
Terra Linda Farms	TL-5	yes	1,008	8	26	2	37	22	366	1,374	6
AES Mendota	Men.Biomass	no	893	11	18	2	31	20	311	1,204	6
Silver Creek Packing	SC-5	yes	2,171	6	11	2	19	19		2,362	10
Coelho/Gardner/ Hanson	CGH-7	yes	1,252	18	13	1	33	13	329	1,581	4
Meyers Farming	MS-5	yes	1,858	19	14	2	34	15	345	2,203	4

1. The initial concentration at each well is based on model results at the end of the 1999-2002 year calibration period.

Table 4-4. Predicted TDS in the Mendota Pool at the MWA Due to Proposed MPG Pumping

In 2004 (Year 2):

Month	Flow Contribution at MWA: DMC[1] (af)	Flow Contribution at MWA: MPG Wells[2] Transfer Pumping (af)	Flow Contribution at MWA: MPG Wells[2] Adjacent Pumping (af)	Ambient TDS Concentration[3] (mg/L)	TDS Increase Due to MPG Pumping: Transfer Pumping (mg/L)	TDS Increase Due to MPG Pumping: Adjacent Pumping (mg/L)	Calculated TDS at Mendota Wildlife Area (mg/L)
January	1,862	0	243	439	0	17	455
February	10,781	0	454	401	0	17	418
March	2,040	1,259	484	426	77	37	539
April	2,264	1,715	581	360	128	53	541
May	10,710	2,844	463	352	93	21	465
June	18,003	2,829	1,583	302	73	49	424
July	18,833	2,813	1,784	243	77	57	377
August	13,257	2,731	1,829	255	97	74	426
September	5,230	2,224	483	286	124	38	448
October	5,733	2,118	740	293	105	48	446
November	2,146	1,196	188	331	94	21	446
December	2,320	0	0	391	0	0	391
Total	**93,179**	**19,729**	**8,831**				
Partial Mean[4]				**316**	**96**	**39**	**457**
Annual Mean				**340**	**-**	**-**	**448**

In 2012 (Year 10):

January	1,862	0	243	439	0	45	483
February	10,781	0	454	401	0	26	427
March	2,217	1,083	484	426	111	61	598
April	2,524	1,455	581	360	160	78	598
May	10,710	2,844	463	352	133	30	515
June	18,135	2,696	1,583	302	89	68	458
July	18,970	2,676	1,784	243	91	77	410
August	13,394	2,594	1,829	255	115	100	470
September	5,884	1,581	471	286	110	51	446
October	6,435	1,406	751	293	86	69	448
November	2,649	693	188	331	84	34	449
December	2,320	0	0	391	0	0	391
Total	**95,880**	**17,028**	**8,830**				
Partial Mean[4]				**316**	**109**	**58**	**488**
Annual Mean				**340**	**-**	**-**	**475**

1. Calculated as the difference between the 2002 net demand at the southern end of the Fresno Slough and the inflow from MPG wells along the Fresno Slough.
2. Inflow from MPG wells along the Fresno Slough.
3. Monthly average based on daily average EC measurements at the DMC terminus (Check 21) between January 1993 and October 2002. EC measuremants were converted to TDS using the regression equation TDS=-14.46+0.6426*EC (based on statistical analysis of 2000-2001 surface water quality data, n=108).
4. Mean calculated during months when MPG transfer pumping is occurring (March-November), except TDS increase due to adjacent pumping (January-November).

Table 4-5. Predicted Boron Concentrations in the Mendota Pool at the MWA Due to Proposed MPG Pumping (2004)

Month	Flow Contribution at MWA			Ambient Boron Concentration[3] (mg/L)	Boron Conc. Change Due to MPG Pumping		Calculated Boron Concentration at MWA (mg/L)
	DMC[1] (af)	MPG Wells[2] Transfer Pumping (af)	MPG Wells[2] Adjacent Pumping (af)		Transfer Pumping (mg/L)	Adjacent Pumping (mg/L)	
January	1,862	0	243	0.17	0.00	0.02	0.19
February	10,781	0	454	0.17	0.00	0.01	0.18
March	1,951	1,348	484	0.17	0.05	0.02	0.23
April	2,264	1,715	581	0.17	0.06	0.02	0.25
May	10,710	2,844	463	0.17	0.04	0.01	0.22
June	18,003	2,829	1,583	0.20	0.03	0.02	0.24
July	18,833	2,813	1,784	0.15	0.03	0.02	0.21
August	13,257	2,731	1,829	0.13	0.04	0.03	0.21
September	5,084	2,370	483	0.14	0.06	0.02	0.22
October	5,609	2,242	740	0.20	0.04	0.02	0.26
November	2,033	1,309	188	0.15	0.05	0.01	0.21
December	2,320	0	0	0.15	0.00	0.00	0.15
Total	**92,707**	**20,202**	**8,831**				
Partial Mean[4]				**0.16**	**0.04**	**0.02**	**0.23**
Annual Mean				**0.16**	**-**	**-**	**0.21**

1. Calculated as the difference between the 2002 net demand at the southern end of the Fresno Slough and the inflow from MPG wells along the Fresno Slough.
2. Inflow from MPG wells along the Fresno Slough.
3. 2002 analytical results. January-May based on the average of June and November. December based on November.
4. Mean calculated during months when MPG transfer pumping is occurring (March-November), except concentration change due to adjacent pumping (January-November).

Table 4-6. Predicted TDS Concentration in the San Joaquin River at Mendota Dam Due to Proposed MPG Pumping (2004)

Moderate Flow Conditions in the San Joaquin River (based on 1999-2000):

Month	Flow Contribution (af) SJR[1]	DMC[2]	MPG	TDS (mg/L) SJR[3]	DMC[4]	MPG[5]	Change in TDS Conc. Due to MPG Pumping (mg/L)	Calculated TDS Concentration at Mendota Dam (mg/L)
January	8,731	3,120	0	140	439	0	0	219
February	14,937	2,406	0	140	401	0	0	176
March	32,185	0	0	140	426	0	0	140
April	5,292	13,694	2,007	140	360	319	2	301
May	222	22,330	2,923	140	352	326	-3	347
June	7,460	34,856	0	140	302	0	0	273
July	7,385	39,282	0	140	243	0	0	226
August	3,345	34,831	0	140	255	0	0	245
September	1,998	15,415	1,262	140	286	317	3	273
October	934	8,607	2,602	140	293	316	8	287
November	819	6403	1,218	140	331	273	-5	304
December	1,279	7,500	0	140	391	0	0	354
Total	**84,587**	**188,444**	**10,010**					
Mean				**140**	**340**	**129**	**0**	**262**

Low Flow Conditions in the San Joaquin River (based on 2001-2002):

January	1,091	10,760	0	140	439	0	0	411
February	141	17,202	0	140	401	0	0	399
March	84	22,180	0	140	426	0	0	425
April	0	18,986	2,007	140	360	319	-4	356
May	0	22,552	2,923	140	352	326	-3	349
June	0	42,316	0	140	302	0	0	302
July	0	46,667	0	140	243	0	0	243
August	0	38,175	0	140	255	0	0	255
September	79	17,334	1,262	140	286	317	2	288
October	0	9,542	2,602	140	293	316	5	298
November	0	7223	1,218	140	331	273	-8	323
December	0	8,779	0	140	391	0	0	391
Total	**1,395**	**261,715**	**10,010**					
Mean				**140**	**340**	**129**	**-1**	**337**

1. Mean San Joaquin River flow contribution (1999-00 moderate; 2001-02 low) to the Mendota Pool (from daily SJDMWA data). January and December 1999/00 and 2001/02 were excluded because the Pool was drained for maintanance.
2. DMC inflow into the model area (northeast of the Main Canal) was calculated as the difference between the sum of the outflows to Columbia Canal Co., NLF, and Mendota Dam and the sum of inflows from the SJR and the MPG wells.
3. Based on a February 1999 grab sample from the Columbia Canal intake, when the San Joaquin River was flowing (lowest TDS measured in a grab sample from the Pool during 1999-2000).
4. Monthly average based on daily average EC measurements at the DMC terminus (Check 21) between January 1993 and October 2002. EC measuremants were converted to TDS using the regression equation TDS=-14.46+0.6426*EC (based on statistical analysis of 2000-2001 surface water quality data, n=108).
5. Flow weighted average of MPG wells in FWD included in the proposed project 2004.

Table 4-7. Predicted Boron Concentration in the San Joaquin River at Mendota Dam Due to Proposed MPG Pumping (2004)

Moderate Flow Conditions in the San Joaquin River (based on 1999-2000):

	Flow Contribution (af)			Boron (mg/L)			Change in Boron Conc. Due to MPG Pumping (mg/L)	Calculated Boron Concentration at Mendota Dam (mg/L)
Month	SJR[1]	DMC[2]	MPG	SJR[3]	DMC[4]	MPG[5]		
January	8,731	3,120	0	0.15	0.17	0.00	0.00	0.16
February	14,937	2,406	0	0.15	0.17	0.00	0.00	0.15
March	32,185	0	0	0.15	0.17	0.00	0.00	0.15
April	5,292	13,694	2,007	0.15	0.17	0.13	0.00	0.16
May	222	22,330	2,923	0.15	0.17	0.14	0.00	0.17
June	7,460	34,856	0	0.15	0.20	0.00	0.00	0.19
July	7,385	39,282	0	0.15	0.15	0.00	0.00	0.15
August	3,345	34,831	0	0.15	0.13	0.00	0.00	0.13
September	1,998	15,415	1,262	0.15	0.14	0.14	0.00	0.14
October	934	8,607	2,602	0.15	0.20	0.14	-0.01	0.18
November	819	6403	1,218	0.15	0.15	0.08	-0.01	0.14
December	1,279	7,500	0	0.15	0.15	0.00	0.00	0.15
Total	**84,587**	**188,444**	**10,010**					
Mean				**0.15**	**0.16**	**0.12**	**0.00**	**0.16**

Low Flow Conditions in the San Joaquin River (based on 2001-2002):

January	1,091	10,760	0	0.15	0.17	0.00	0.00	0.17
February	141	17,202	0	0.15	0.17	0.00	0.00	0.17
March	84	22,180	0	0.15	0.17	0.00	0.00	0.17
April	0	18,986	2,007	0.15	0.17	0.13	0.00	0.17
May	0	22,552	2,923	0.15	0.17	0.14	0.00	0.17
June	0	42,316	0	0.15	0.20	0.00	0.00	0.20
July	0	46,667	0	0.15	0.15	0.00	0.00	0.15
August	0	38,175	0	0.15	0.13	0.00	0.00	0.13
September	79	17,334	1,262	0.15	0.14	0.14	0.00	0.14
October	0	9,542	2,602	0.15	0.20	0.14	-0.01	0.19
November	0	7223	1,218	0.15	0.15	0.08	-0.01	0.14
December	0	8,779	0	0.15	0.15	0.00	0.00	0.15
Total	**1,395**	**261,715**	**10,010**					
Mean				**0.15**	**0.16**	**0.12**	**0.00**	**0.16**

1. Mean San Joaquin River flow contribution (1999-00 moderate; 2001-02 low) to the Mendota Pool (from daily SJDMWA data). January and December 1999/00 and 2001/02 were excluded because the Pool was drained for maintanance.
2. DMC inflow into the model area (northeast of the Main Canal) was calculated as the difference between the sum of the outflows to Columbia Canal Co., NLF, and Mendota Dam and the sum of inflows from the SJR and the MPG wells.
3. Based on a February 1999 grab-sample result taken at the Columbia Canal, when the San Joaquin River was flowing.
4. 2002 analytical results. January-May based on the average of June and November. December based on November.
5. Flow weighted average of MPG wells in FWD included in the proposed project 2004. Mean calculated only for months when transfer pumping occurred.

Table 4-8. Summary of Costs of Exchanged Water for Each Alternative

Alternative	Total Cost (10 years)	Acre foot equivalents	Cost/Af
Proposed Action	$19,804,648	200,000	$99
Well Construction	$57,760,201	200,000	$289
Land Fallowing (crop losses)	$160,278,089	200,000	$801
Land Fallowing (labor)	$12,480,000	200,000	$62

Table 4-9. Summary of effects of proposed action and project alternatives.

Resource Area	Potential Effect	Proposed Action	New Well Construction	Land Fallowing
Groundwater Level				
	Short-term effects	-	--	0
	Long-term effects	0	--	0
	Madera County	0	0	0
Land Subsidence				
	Localized subsidence	0	--	0
	Infrastructure effects	0	--	0
Groundwater Quality				
	Beneficial use	--	0	0
Surface Water Quality				
	Beneficial use	0	0	0
	TMDLs	0	0	0
	Agricultural return flows	0	0	0
Sediment Quality		0	0	0
Biological Resources				
	Habitat effects	0	0	-
	Irrigation water quality	-	0	0
	Toxicity	0	0	0
	Sediment quality	0	0	0
	Special-Status Species	0	0	0
Cost of Water (or equivalent)		0	--	--
CVP Operations				
	San Luis Canal	0	--	0
	San Luis Reservoir	-	0	0
	Power	0	0	0
Archaeological and Cultural Resources		0	0	0
Indian Trust Assets		0	0	0
Environmental Justice		0	0	0
Socioeconomic				
	Farm income	0	-	--
	Worker income	0	0	-
Land Use and Traffic		0	0	0
Air Quality		0	0	0
Noise		0	0	0

-- Significant Negative effect on resource

- Potential Negative effect on resource

0 No effect on resource

+ Potential Beneficial effect on resource

++ Significant beneficial effect on resource

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This draft EA was prepared by ENTRIX, Inc. and Luhdorff and Scalmanini Consulting Engineers under the direction of the U.S. Bureau of Reclamation staff. The following individuals were instrumental in preparing this document or in providing review comments.

U.S. Bureau of Reclamation
Kevin Moody – project coordinator
Rosalie Faubion – reviewer
Kathy Wood – reviewer
Lynne Silva – reviewer
David Young – project coordinator
Sheryl Carter – reviewer
Chris Eacock – reviewer
Michael Jackson – Deputy Area Manager

Mendota Pool Group
William Pipes – MPG representative
Marc Carpenter – MPG representative
William C. Kuhs – reviewer

San Joaquin River Exchange Contractors Water Authority
Steve Chedester - reviewer
Kenneth D. Schmidt – reviewer

Newhall Land and Farming Co.
John Frye – reviewer
Kenneth D. Schmidt – reviewer

James Irrigation District and Tranquillity Irrigation District
James R. Provost – reviewer

California Department of Fish and Game
Dr. Andrew Gordus - reviewer
W.E. Loudermilk – reviewer

ENTRIX, Inc.
Theodore E. Donn, Jr., Ph.D. – project manager
James D. Tull – project sponsor
Judy Nedoff
Tula Economou, R.G.
Teresa Fung
Richard McCartney, R.G.
Chelsea Ayala
Ruth Sundermeyer

Luhdorff and Scalmanini Consulting Engineers
Glenn Browning – project manager
Vicki Kretsinger
Till Angermann

Term	Definition
A-Clay	A discontinuous clay layer about 10 to 30 feet thick that underlies portions of the western side of the San Joaquin Valley at a depth of between 70 and 130 feet below ground surface. The A-clay pinches out east of San Mateo Road and west of the Mendota Airport.
Corcoran Clay	A clay layer that underlies much the San Joaquin Valley. In the Mendota area, it is about 50 feet thick and about 350 to 450 feet below ground surface.
Deep groundwater	Groundwater that is present between the A-clay (or its equivalent depth) and the Corcoran Clay. Wells penetrating this stratum are generally between 130 and 400 feet deep.
Electrical conductivity	A measure of the ability of a liquid to conduct electricity. Electrical conductivity increases with the amount of dissolved salts in the liquid. Electrical conductivity is often used to estimate salinity. Electrical conductivity can be empirically related to total dissolved solids as described below.
Exchange	A regulatory term referring to the trade, with the U.S. Bureau of Reclamation, of water in one location for an equivalent amount of water from some other source or location.
Fallow	Agricultural lands that have been temporarily taken out of production (< 2 years) and will be returned to production as part of normal crop rotation. Lands are subject to weed control and disking. Fallow lands can be brought back into production immediately.
Idle	Agricultural lands that have been removed from production for a period of greater than 2 years. Idle lands are not subjected to weed control. Idle lands would require would require significant amendments to make them suitable for agriculture.
Retired	Agricultural lands that have been permanently removed from production.
Salinity	A measure of the amount of dissolved salts in water. As used in this document, salinity is a general term referring to the concentration of

	salts as measured by either electrical conductivity or total dissolved solids.
Shallow groundwater	Groundwater that is found above the A-Clay (or its equivalent depth). Wells penetrating this stratum are generally less than 130 feet deep.
Total dissolved solids	A measure of the mass of dissolved salts and minerals in a given volume of water, expressed as mg/L, and often used as a measure of salinity. Because of the variable mixture of salts in water, a theoretical relationship between TDS and EC cannot be derived. Based on direct measurements of TDS and EC in Mendota Pool surface waters, the following empirical relationship has been developed: TDS = 0.6426 * (EC) - 14.46.
Transfer pumping	A term of convenience referring to all water pumped into the Mendota Pool by the MPG for exchange with U.S. Bureau of Reclamation, delivery to Westlands Water District, and/or trade or sale to others. Transfer pumping does not include water pumped into Mendota Pool for use on “adjacent” lands.